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ABSTRACT

This packet is composed of several resources for teachers interested in prairie ecology and restoration. "A Guide to Restoration from Site Analysis to Management" focuses on the Prairie/Oak Savanna communities of Wisconsin and takes teachers through the planning and design process for a restoration project on school grounds including site analysis, biotic community selection, species selection, site preparation, plant or seed procurement, planting, post-planting care, and long-term management. The Prairie Activity Guide is a sampler of activities that can be used to embark on a prairie restoration. Activities can be used with K-12 students and cover subjects such as science, mathematics, language arts, social studies, art, and music. Activities are organized into seven units: (1) "Prairie Definition and Introduction"; (2) "Human Habitation and Cultural History"; (3) "Prairie Plants"; (4) "Prairie Insects, Birds and Mammals"; (5) "Ecosystem Interactions"; (6) "Restoration"; and (7) "Integrative Activities and General Strategies." Other items in the packet include a Scope and Sequence pamphlet which categorizes activities according to grade level and subject, plant species lists and range maps, propagation guidelines, seed-collecting dates, bibliographies, resources lists, and a native plant nursery list. (PVD)

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Prairie Restoration for Wisconsin Schools

by

Molly Fifield Murray and Robin McC. Greenler

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Prairie Restoration for Wisconsin Schools

A Guide to Restoration from Site Analysis to Management

Molly Fifield M[illegible]

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Prairie Restoration for Wisconsin Schools

A Guide to Restoration from Site Analysis to Management

Written by Molly Fifield Murray

From the Earthkeeping Program at the
University of Wisconsin–Madison Arboretum
1993

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Note: Wherever this symbol appears, a supporting educational activity may be found in the companion booklet, *A Prairie Curriculum Sampler*. The number inside the symbol refers to the activity number in the sampler. Ideas cover a wide range of curriculum areas for grades K-12.

Teachers at the Arboretum's prairie restoration workshop walk in a prairie remnant. The process of restoring the land fosters great camaraderie among strangers.

PREFACE

High school science teacher Greg Bisbee had a problem. At his school in downtown Milwaukee, he couldn't take students on field trips without including every student in all of his classes. He wanted to get them outside often for first-hand experiences with nature, but how?

He heard about a workshop, "Celebrating a Prairie Birthday," offered by the University of Wisconsin-Madison Arboretum. Since its founding by Aldo Leopold and colleagues in the 1930s, the Arboretum has been a pioneer in prairie restoration. The workshop promised to show teachers how to restore prairie while involving students at every step. Teachers were encouraged to develop a team from their school.

In June of 1991, Greg and his co-worker Michelle Trevino, a social studies teacher, joined ten other teachers for the Arboretum's first prairie restoration workshop for teachers. In the course of their week together, the teachers reclaimed two overgrown weedy areas of the Arboretum for the restoration of prairie and savanna.

In the process, they came to understand how the biological diversity of the land has diminished since the time it passed from the hands of native people to pioneers. They discovered something else they already felt... that it is not only the land, but our connection with it, that needs to be restored.

In *A Sand County Almanac*, Aldo Leopold speaks of this connection as he lays out the ethical framework for proclaiming our citizenship in a natural world through restoration.

1 There are some who can live without wild things, and some who cannot....

When we see land as a community to which we belong, we may begin to use it with love and respect....

All ethics so far evolved rest upon a single premise: that the individual is a member of a community of interdependent parts....

The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land.

...a land ethic changes the role of Homo Sapiens from conqueror of the land-community to plain member and citizen of it. It implies respect for... fellow-members and also respect for the community as such.

A land ethic then, reflects the existence of an ecological conscience, and this in turn reflects a conviction of individual responsibility for the health of the land.

In putting this ethic into action through restoration, we begin to undo some of the ecological damage done in the past. Ecological restoration fosters a special kind of ecology, restoration ecology, the study of a community through the attempt to restore it. The pioneering efforts at restoration here at the Arboretum began as a way to create biotic communities that could be studied by University students. Over time it became apparent that the process of restoration itself was important for learning about biotic communities

(Jordan, Gilpin and Aber, 1987). Under the leadership of William R. Jordan III, this has been developed into the idea that ecological restoration can be used not only to study the systems through restoration ecology, but can be used in teaching the general public and students about the natural landscape.

In the meantime, parks departments, highway departments, game managers, and private citizens throughout the country are using restoration to enrich the lands under their stewardship. Through ecological restoration, we can develop high quality buffer zones to enlarge and shield fragile remnants from negative impact; establish preserves for native species; and create special places for life-long learning.

Restoration has important implications for education. In restoration- based environmental education, students, teachers, and scientists have a chance to work together to heal the land. Teachers and students can become part of the investigating team, discovering through restoration how ecosystems work. But more importantly, by restoring ecosystems they develop a healthy relationship with the rest of nature (Jordan, 1990).

A growing number of teachers are using ecological restoration to make education relevant and alive and to help create an environmentally conscious and committed citizenry. This guide for planting prairies on school grounds and the accompanying K-12 *Prairie Curriculum Sampler* have been written to support that effort. Although designed with teachers in mind, we hope this guide will also be useful to others interested in prairie restoration.

Acknowledgements

We have consulted with experts in the field of prairie restoration, namely Dr. Virginia Kline, ecologist, U.W.-Madison Arboretum; Dr. Evelyn Howell, chair, Department of Landscape Architecture, U.W.-Madison; Robert Ahrenhoester, owner, Prairie Seed Source; Neil Diboll, owner, Prairie Nursery; Rich Henderson, ecologist, Wisconsin Department of Natural Resources; and Wayne Pauly, naturalist, Dane County Parks.

Special thanks to the following educators for reviewing this material: Ann Delmore, Madison elementary teacher; Pam Festge, Mt. Horeb Agriculture and Conservation instructor; and Gary Loertscher, Principal of Belleville elementary and middle schools. The reviewers range from the uninitiated to the experienced in prairie restoration.

This material is part of the Earthkeeping program of outreach education at the University of Wisconsin–Madison Arboretum. Greg Armstrong, Arboretum Director, has provided leadership and support throughout its development. Brock Woods, Education Program Manager, has been instrumental in developing the ideas and direction of Earthkeeping at the Arboretum. Other staff members supplied valuable advice and comments, especially Donna Thomas.

This work has been supported in part by a grant from the Center for Biology Education at the University of Wisconsin-Madison. Teacher workshops have been supported by grants from the Wisconsin Environmental Education Board and the Center for Biology Education.

About the Author

Molly Fifield Murray has a Masters degree in landscape architecture from the U.W.–Madison Department of Landscape Architecture, where she was trained and inspired by Darrel Morrison and Evelyn Howell. She has 16 years experience in native plant landscape design based on plant community concepts. At the Arboretum she has been doing restoration-based environmental education, education program development, and ecological restoration since 1986. Ms. Murray is currently project leader for an oak savanna restoration project; instructor in the restoration-based environmental education program; and naturalist for weekend public Earthkeeping tours.

Native Biotic Communities
The Basis for Beginning

Introduction

Native biological communities include a variety of plant and animal species that have evolved together, each adapted to its regional and local environments. "Each species has individual environmental limits" (Curtis, p.3). Those species that have similar limits tend to grow together. No two species have exactly the same limits, so the communities in which they grow lack precise boundaries and occur along a continuum of natural parameters, including moisture and soil-type gradations.

Prairies, savannas, and eastern deciduous forests are among many of the native biological communities that exist on the North American continent. Wisconsin is on the edge of the prairie region, where prairie and forest biomes meet and struggle against each other for existence.

This guide focuses on the Prairie/Oak Savanna communities that dominated Wisconsin south of the "tension zone" as recently as 160 years ago. Shaped by aeons of geologic and climatic change, and situated on the soils they helped create, these communities were home to native plants, animals, and people. Prairies covered 2.1 million acres in Wisconsin; two types of savanna—oak openings and oak barrens—covered almost 7.3 million acres.

Prairie: A Special Place

When French explorers and missionaries tried to describe the vast grasslands they encountered near and beyond the Mississippi river, they used the word "prairie" or "meadow." The early travelers were awed by the beauty and abundance found in these open lands.

JOHN CURTIS, a botany professor at the University of Wisconsin-Madison, studied and analyzed vegetation with his students in over 1400 examples of prairie, forest, and wetland communities throughout Wisconsin. In 1959, Curtis' The Vegetation of Wisconsin was published, the first complete documentation of the vegetation of an entire state. Using data collected in the field by his students, he summarized the species composition, geographical limits, and environmental relations of the natural communities of the state. With this information as a starting point, land managers and scholars have been able to study the vegetation of the area within a framework. It enables those who are interested in preserving and restoring the native vegetation of the state to gain an understanding of what that vegetation is and what environmental forces affect it.

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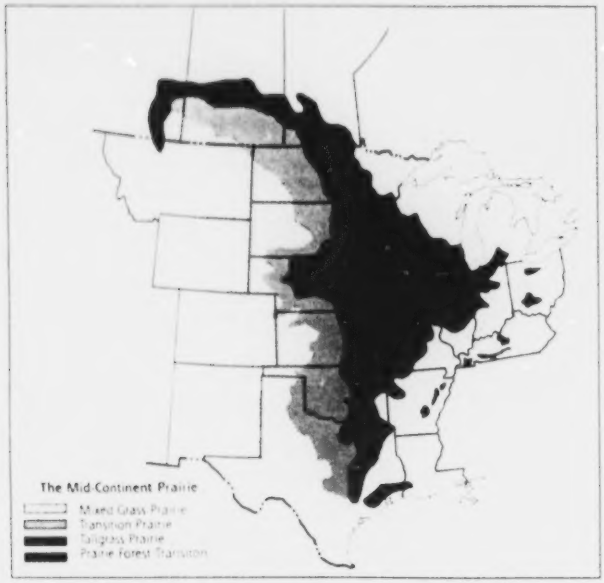
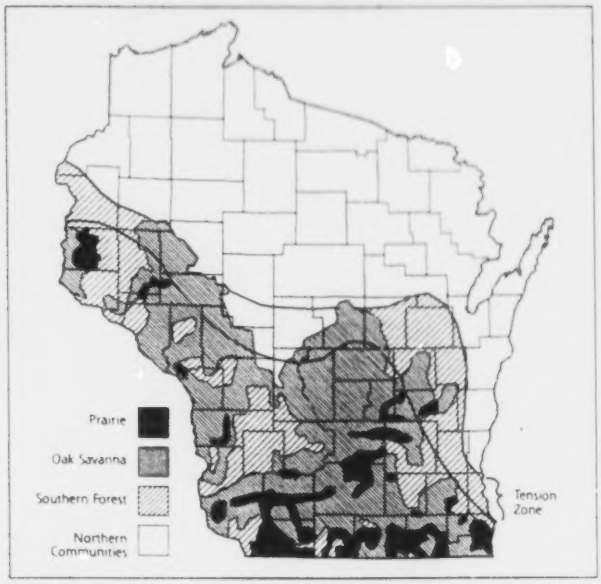


Extent of prairie in the midwest before settlement by Europeans (courtesy of David Costello).



Map of Wisconsin showing presettlement prairie and savanna, south of tension zone. Adapted from Curtis.

3 **...in every direction, prairies only, as far as the eye can reach....All this prairie affords ample subsistence to the elk not infrequently encountered in herds of four or five hundred each. These by their abundance, furnish adequate provision for whole villages, which therefore are not obliged to scatter by families during the hunting season.** *(Father Dablon, 1670, quoted in Curtis, p. 263)*

By reading surveyors' records and pioneer journals, we gaze through their eyes on sights unseen in the East or in Europe, which was dominated by vast forests, meadows of short grasses, and small farms. Many pioneers likened the prairie to the ocean when the wind blew waves across the grasses. They even had to navigate as if on the ocean, for the prairie often lacked landmarks.

4 **On the summit levels spreads the wide prairie, decked with flowers of the gayest hue; its long and undulating waves stretching away till sky and meadow mingle in the distant horizon.** *(Owen, 1848, quoted in Curtis, p. 264)*

Laura Ingalls Wilder describes the prairie and many of the mixed emotions that pioneers felt about it in her books about pioneer life. In *By the Shores of Silver Lake*, she writes of a time when the Ingalls family was building a shanty on their homestead claim in South Dakota.

> Ma said, "I would like to see some trees again myself. They would rest my eyes from all this prairie with not a tree. Not even a bush to be seen in any direction."

Pa reminds her that every homesteader must plant ten acres of trees, and he isn't sure it's a good idea. "Trees spread, and you know what it was like back in the Big Woods of Wisconsin, grubbing out stumps and breaking our backs on the sprouting hoe to keep a little land clear for crops. It's restful to have clear prairie land like this, if you're going to farm."

But the next day Pa brings some cottonwood trees from a grove to plant around the shanty anyway. While they are planting, baby Grace toddles away and is lost. Everyone is frantic that she has wandered into the tall grasses of the slough and will never be found.

> Laura was running straight toward the south. Grass whipped soft against her bare feet. Butterflies fluttered over the flowers. There wasn't a bush nor a weed that Grace could be hidden behind. There was nothing, nothing but grass and flowers swaying in the sunshine. . . . She ran on and on. Grace must have gone this way. Maybe she chased a butterfly.

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She didn't go into Big Slough! She didn't climb the hill, she wasn't there.

Oh, baby sister, I couldn't see you anywhere east or south on this hateful prairie.

"Grace!"

This horrible, sunny prairie was so large. No lost baby could ever be found on it. Ma's calling and Pa's shouts came from Big Slough. They were thin cries, lost in wind, lost on the enormous bigness of the prairie.

. . . [Laura] ran up a low slope. Nothing, nothing, not a spot of shadow was anywhere on the level prairie all around her. She ran on, and suddenly the ground dropped before her. She almost fell down a steep bank.

There was Grace. There in a great pool of blue, sat Grace. The sun shone on her golden hair blowing in the wind. She looked up at Laura with big eyes as blue as violets. Her hands were full of violets. She held them up to Laura and said, "Sweet! Sweet!"

. . .They were surrounded by masses of violets blossoming above low-spreading leaves. Violets covered the flat bottom of a large, round hollow. All around this lake of violets, grassy banks rose almost straight up to the prairie-level. There in the round, low place the wind hardly disturbed the fragrance of the violets. The sun was warm there, the sky was overhead, the green walls of grass curved all around, and butterflies fluttered over the crowding violet faces.

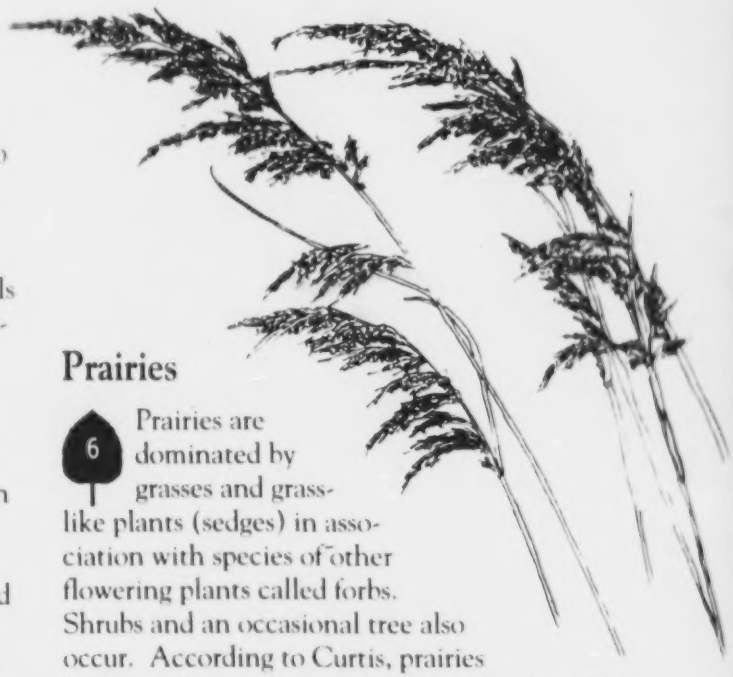
5

Thanks to restoration, I have known such a magical place. On May 18, 1986, I walked with other naturalists to a forty-acre prairie restoration at the Arboretum. The prairie had been burned that spring, and as we emerged from a trail that descended from the woods, Greene Prairie looked like just another green, grassy area to me—until one of the naturalists cried out with joy. Masses of blue lupine covering over six acres of the hill in the distance greeted us. As we went out onto the trail, stars of blue-eyed grass and yellow star grass twinkled up from among the knee-high greenery. Deep pink patches of downy phlox, wood betony, toadflax. In all, more than twenty species were blooming that day.

The hope of restoration is to bring us all face to face with the wonder of the world that sustains us by getting to know a natural place intimately. To grow in awareness. To learn. And to make and share a commitment to far-sighted actions and lifestyles. In this way, we work together to preserve, recreate, and sustain native ecological communities and the quality of life on this planet.

Descriptions of Prairie and Savanna

In his book, John Curtis described many grassland communities. In reality these occur along a continuum of moisture and soil types that blend into one another gradually, but are here presented separately for discussion purposes.



Prairies

6

Prairies are dominated by grasses and grass-like plants (sedges) in association with species of other flowering plants called forbs. Shrubs and an occasional tree also occur. According to Curtis, prairies have less than one tree per acre, and at least 50% of the cover of grass-like plants are grass species.

Prairies occur in full sun and require at least twelve hours of daylight per day during the growing season. As mentioned, grasses form 50 to 90% of the cover, but only a few species of grasses form this matrix. However, a large variety of forb

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species, each present in small numbers, can account for up to 80% of the total number of species on a site. On the Arboretum's Greene Prairie, for example, there are almost 300 species of plants. Even though less than 10% of the species are grasses, grass stems and leaves cover a large proportion of the prairie. This structure is important to remember when you are trying to plant a prairie.

Among the prairie forbs, some families are better represented than others. Plants from the daisy, legume, rose, milkweed, and mint families are very important to the structure, visual impact, and function of the community.

Dry (xeric) prairies occur on rocky, shallow soils or sand and are dominated by short grasses such as little bluestem and sideoats grama. In general, the stature of all plants on dry prairies is short.

Mesic prairies are found on rich soils with moderate moisture available—now good corn land. Mesic prairies are dominated by tall grasses such as big bluestem and Indian grass. In the spring, the plants are short, and flowers bloom close to the ground. The height of bloom of later species increases as the prairie stretches higher throughout the summer. By late summer, flowers may reach four to six feet high, and the grasses often reach even greater heights.

Wet prairies have moisture near the surface but do not have standing water for long periods of time. They have a variety of tall grasses and sedges, as well as forbs. Wet prairies have fewer early spring flowers because of cold air drainage.

Savannas

Savannas can be defined as having one tree or more per acre, but with less than 50% of the area covered by trees (Curtis, p. 330). Among the trees were herbaceous woodland plants often grading into mostly prairie species in sunny openings. Some believe that savannas were communities with a distinct group of plants, not just some plants from woods and some plants from prairies (Packard, 1988). Some species grew best in sunny openings, some in partial shade, and some in denser shade under the trees.

Changes Since Settlement

Together, prairie and oak savanna once covered 9,400,000 acres in Wisconsin. Today, those acres comprise some of the richest agricultural soils in our state. That natural process of soil building took many hundreds of years—roots recycling, dying and growing to depths of six to twelve feet; animals, such as prairie ants, mixing this organic material with minerals and byproducts from all the biota; legumes and their associated nitrogen fixers, special bacteria, incorporating nitrogen from the air into the soil; fires, consuming the fuel of dried vegetation and stimulating new growth.

The productivity of these soils attracted immigrant farmers. To the newcomers, however, the native plants had no apparent economic value. And in order to succeed, they imposed plants and animals on the land that could be sold to markets created by the urbanizing, industrial East.

The savannas were prime homestead sites. Park-like in appearance, they offered beauty and space for home and pasture. The oak trees provided wood for cabins, barns, fences, furnishings, and fuel. They also offered relief from the intense sun of the open prairie.

The burr oak openings are among the most productive portions of the State being especially adapted to the continued production of wheat. They are, moreover, the most beautiful portions of the varied and picturesque surface of the country. Grouped here and there, like so many old orchards, on the summit of a gentle swell of land or on the border of a marsh, prairie or lake, there is nothing in the whole catalogue of American sylva that equals these burr oaks for the charming, homestead-like expressions they give to the landscape. *(Hoyt, 1860, quoted in Curtis, p. 329)*

This native landscape of lush, expansive grasslands interspersed with groves of oaks not only defined the visual character of the Midwest but

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Prairie plants survive drought, harsh winters and fire through adaptations. Most prairie plants have about two-thirds of their mass below ground.

Deprived of covering vegetation and its binding roots, soil is eroded by rain and wind.

also influenced the way the land was settled. Settlement occurred first around water and groves, where small farms were able to sustain a family. The diverse prairie grassland has now been replaced mainly by a monoculture grassland of corn.

Wildfires and those set by native people had burned over the land for thousands of years. Those fires were an essential part of the prairie/savanna ecosystem. They maintained the openness of the communities by setting back young trees and shrubs. Many of the oak woods communities of today are the result of the cessation of fire at European settlement time.

8 Prairie grasses and forbs survive fires because they have buds at or below the soil surface and a lot of root mass below ground compared to the biomass of the plant above ground. Remarkable root systems of many prairie species reach depths of over six feet. Some extend even as deep as twenty feet.

Those roots presented problems to the prairie pioneer. Iron and wooden plows couldn't break the prairie. But once the steel mold-board plow was invented by John Deere, the farmer had a tool that was able to cut the deep prairie roots, turn the soil, and plant crops. People say it sounded like fiddle strings snapping as the steel plow sliced through the roots.

Unfortunately, stripped of prairie vegetation and sometimes subjected to unsound agricultural practices, tons of soil per acre have been lost to erosion. In recent years, conservation efforts have aimed to prevent further loss of soil and fertility through enlightened farming practices. Some of these efforts include planting native prairie species on set-aside land in the Midwest and rangeland in the West, in order to rebuild the soil.

9 The prairies disappeared one field, one house at a time until less than one tenth of one percent remains. Remnants occur along old railroads, in pioneer cemeteries, or on sites too rocky or steep for agriculture. Others can be found where farmers or landowners saved a few rare acres of natural prairie for their own precious value and beauty.

Even greater destruction of savannas occurred. They became either homesites, pastures, or towns. In many cases, the cessation of fires allowed savanna areas to grow up into woods. They are so rare today that it is difficult to find in Wisconsin a savanna with an intact ground layer to study as a model for restoration.

This near extinction of entire ecosystems in southern Wisconsin makes preservation and restoration of prairies and savannas urgent. The loss of native plant communities often means the loss of plant and animal species that are not able to survive in an impoverished or diminished environment. The surest way to save threatened and endangered species is to save the entire biotic community in which they live.

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Fire was a natural part of a functioning prairie/savanna ecosystem. Set by lightning or Native Americans, fires burned frequently over the prairie until stopped by a river or other natural barrier. These fires inspired both awe and fear in early settlers.

In less than 200 years, most native Midwestern landscapes have been eliminated or drastically changed by modern society. By eliminating these plant communities, part of the character of the Midwest has been lost. Pioneers like Laura Ingalls Wilder would no longer recognize it.

10 When Laura found her baby sister, Grace, sitting in a large, round, flat-bottomed depression covered with violets, she wondered if the place was a fairy ring. "A place like that couldn't just happen, Pa. Something made it," she said.

Pa replied, "You are right, Laura; human hands didn't make that place, ... but your fairies were big ugly brutes, with horns on their heads and humps on their backs."

Laura found Grace in a buffalo wallow.

No remnant Wisconsin prairie is large enough today to support a herd of bison (buffalo) or elk, or a pack of wolves. Even smaller animals such as prairie chickens need thousands of acres of habitat to sustain their populations. We are just beginning to ask questions like "What are the requirements for certain species of rare butterflies?" and "Can frogs be restored to a prairie pond?"

Restorationists are now realizing that without all members of the community, some links and processes of a "natural prairie" will be missing, putting the whole system at risk. Lessons such as this have been part of restoration since the first prairie ever planted was started at the Arboretum by Ted Sperry and crew members from the Civilian Conservation Corps in 1935. They planted prairie plants and seeds into a degraded pasture until the war came.

By the late 1940s these plantings were not spreading or competing well with the pasture plants into which they had been set. John Curtis remembered the stories pioneers told of the prairie fires started by lightning or Native Americans. Beautiful but frightening, the fires swept over the land until stopped by rivers, lakes, or a change in weather. Curtis experimented with fire on the Arboretum prairie and found that it was an essential process for the bloom, vigor, and spread of prairie plants. You can see the results of this work on what is now known as Curtis Prairie.

The restoration process is a powerful tool for learning about native plant communities and the natural processes that rule them. As we test and investigate restoration processes, we will be better able to recreate functioning biotic communities. The exciting thing about involving students in this process is that they will be posing questions for which there are yet no answers. They will explore the scientific process as part of a real investigation.

In spite of all that we are learning about prairie restoration, we must remember that the preservation and proper management of existing native remnants is of utmost importance. While serving as reservoirs of biological diversity, they are the real prairie textbooks. We look to them as our models for prairie restoration.

The Restoration Process

Introduction

This booklet will take you through the planning and design process for a restoration project including: site analysis, biotic community selection, species selection, site preparation, plant or seed procurement, planting, post-planting care, and long-term management.

While these terms may at first seem unfamiliar, you can compare the process to gardening. Rather than gardening with annuals, however, you will be dealing with native perennials. So, as in any perennial bed, you will want to plan carefully. The plants will be there for a long time, and you will have invested precious time and resources. Proper site preparation to control weed problems, for example, simplifies long-term maintenance.

Keep in mind that native Wisconsin prairies varied in composition of species and structure. No two prairies were alike. No two existing remnants are alike. Therefore, we can offer no exact cookbook recipe of species for prairie landscaping. Each prairie project will be unique, though similar in structure and appearance.

Site Analysis

Analyzing the restoration site will help you determine which native plant community may have existed on the site before European settlement, which community could be on the site now, and other design considerations necessary for a successful restoration.

Prairie sites need full sun (at least twelve hours of daylight per day during the growing season). Soils and moisture availability may vary but will dictate which species will thrive.

Set Goals

First things first. Ask yourself some basic questions. Why do you want to restore the site? What goals do you have for it? Your goals will drive such decisions as species selection, planting design, and layout of trails, which are discussed in other sections of this booklet. In general, you need to have educational and ecological goals in mind.

Educational goals: Throughout the restoration process, students can learn about local history; develop skills in math, reading, writing, and science; and express their personal feelings and thoughts through the arts. By utilizing a holistic approach, integration of various areas of the cur-

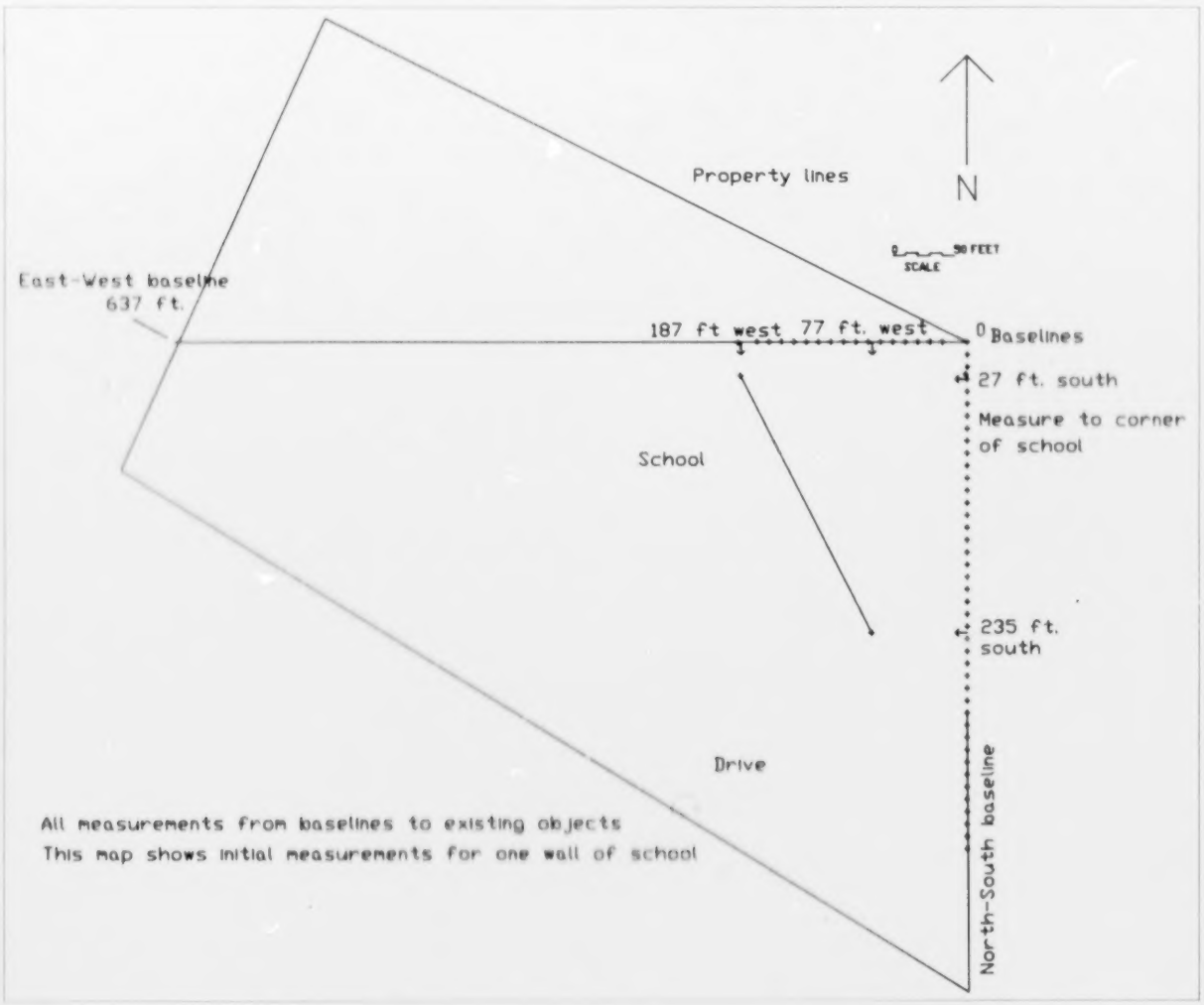
riculum becomes a natural part of the learners' experiences (see UW-Madison Arboretum publication, *A Prairie Curriculum Sampler*).

Ecological goals: Providing wildlife habitat, protecting and enhancing species diversity, and preserving native landscapes are possible ecological goals for a restoration. For example, one might choose to do a savanna restoration in response to the urgent need to try to save species that are disappearing from this rarest of communities. On the other hand, one might choose to plant prairie because more is known about it, plants and seeds are readily available, and models exist upon which to pattern the restoration. What exists on the site already will guide this decision.

Map the Area

A map of the restoration area is essential to long-term planning. First, outline the physical area to be restored. Many schools already have site plans showing measurements of property boundaries. If you don't have a site plan or are not restoring an area along the property boundaries, you have an excellent built-in project for students to measure and represent your site.

Here is one method that works well: Choose a corner of the restoration site. Use a directional compass and a 100-foot tape measure. Walk along the perimeter of the site using the compass to keep you on line. You can use flags or stakes to keep



First establish base lines, property lines, compass directions, and locate the buildings.

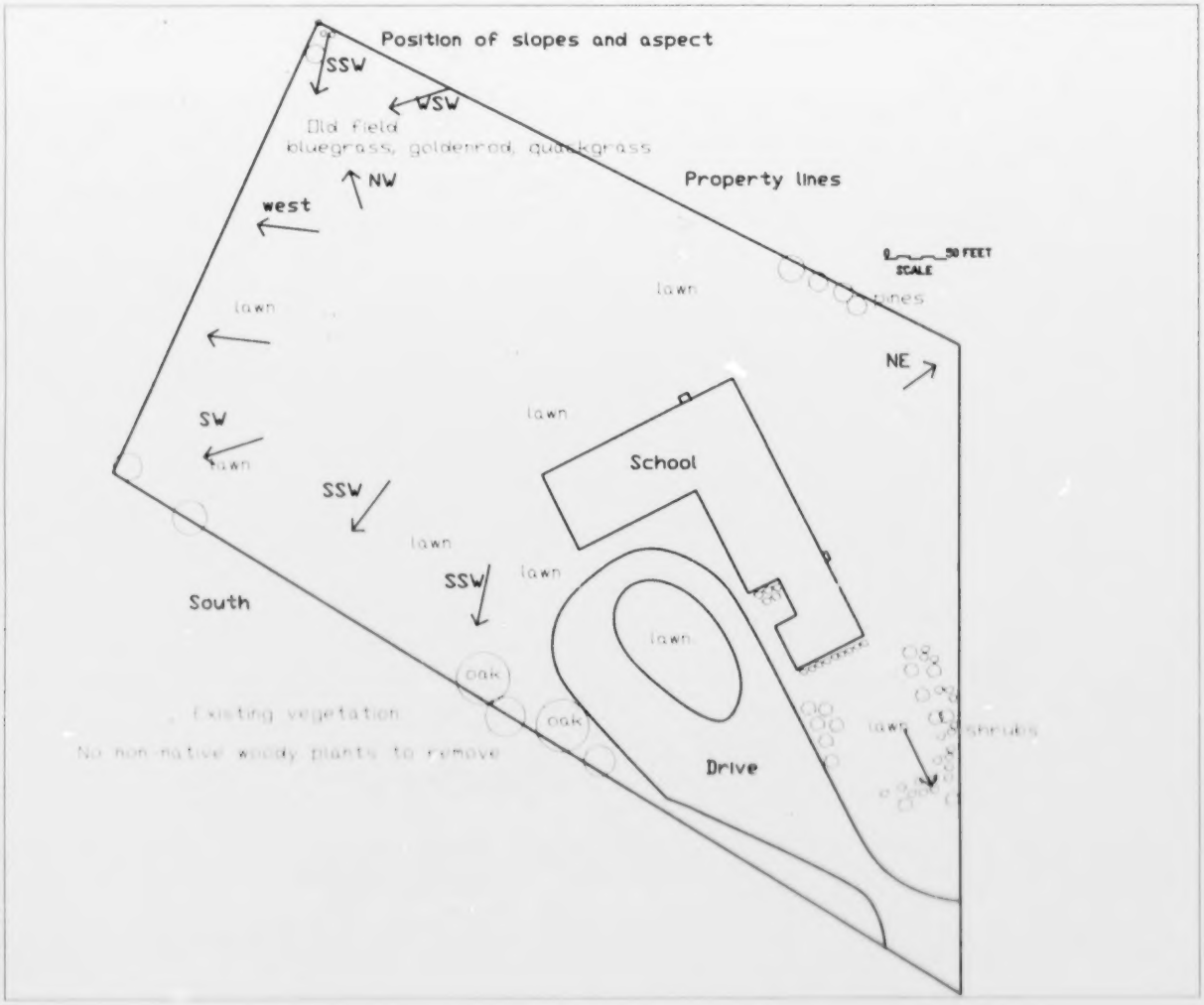
track of each 100-foot distance. On smaller sites you can mark off shorter distances. You will end up with a marked off perimeter delineated by flags.

Once you have the perimeter marked, begin to map objects within the perimeter such as trees, rocks, built objects, and other important features (see steps below). To locate these on the map, measure to them from places on the imaginary grid you have established along the perimeter. For instance, walk from the southwest corner of your site in an easterly direction along the south line until you are directly south of a tree. Note that point, then walk north to the tree, measuring the distance to it. You then know where the tree is in relation to both the south and west lines.

Survey the Existing Vegetation

11 To know how to proceed, you'll need to know what you're starting with. Does the vegetation represent a native plant community? Which species will you keep? Which will have to be removed or managed?

To assist in this process, map all the existing vegetation, starting with trees and shrubs. Measure both the circumference of the trees and their crown extent (how far their branches extend). Do this by simply measuring out from the trunk of the tree until you are standing directly below the end of the branch. Also measure the amount of ground covered by shrubs or groups of shrubs. Have stu-

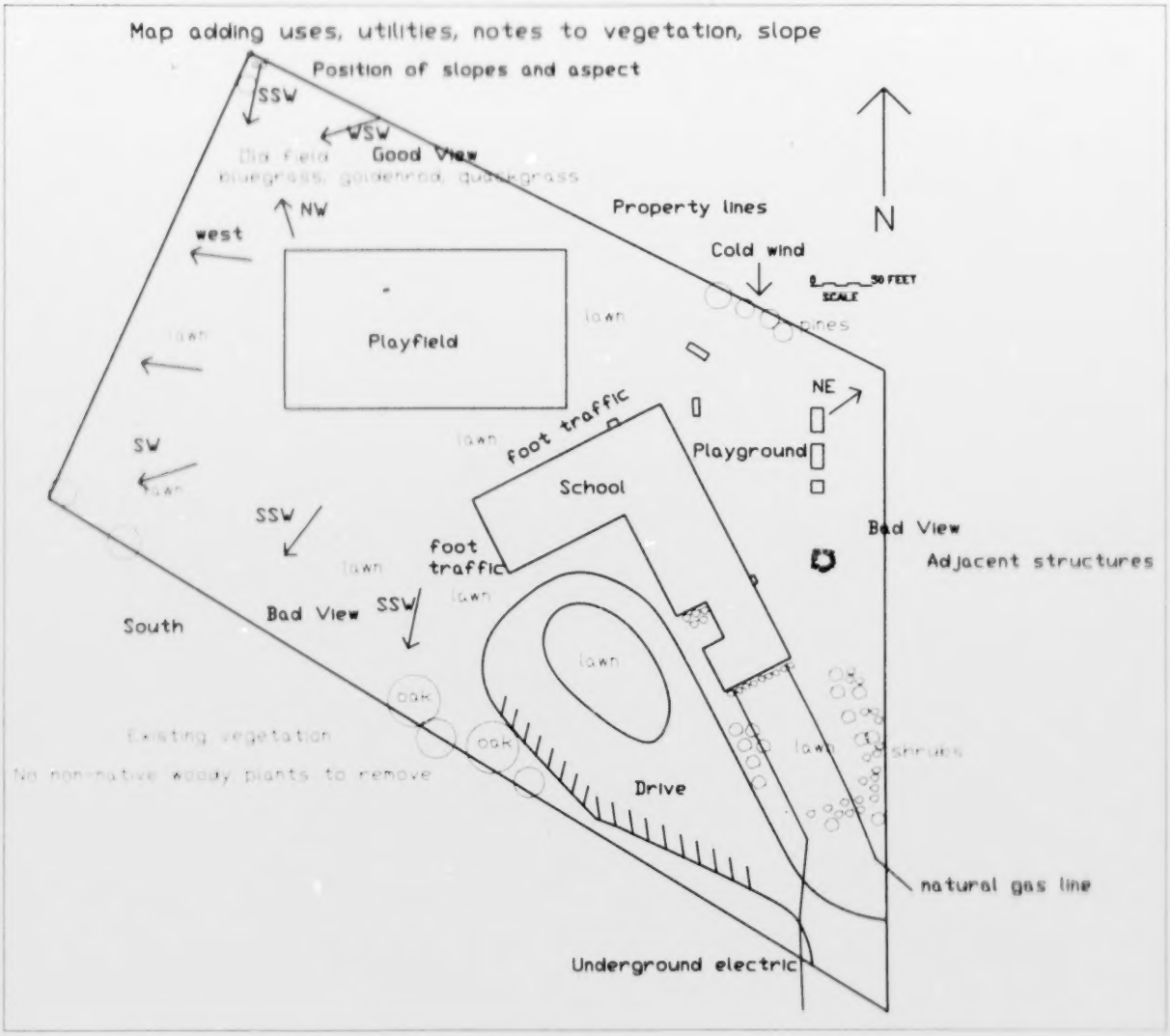


Map existing vegetation, slopes, and direction of slope. Note any non-native vegetation that must be removed.

dents identify and label the location of each species (tree and shrub identification books are listed in the bibliography). This can be done at any time of year for most species, although you may need to wait for leaves to emerge to help identify more difficult ones. Help is often available from county extension agents, university specialists, or other resource people in your area.

Study the Slope or Level of the Site

Map any slopes on the site and determine their extent. You do not need to know the degree of slope, although that is a fine math activity for students in upper grades. It should suffice to make a common sense note of whether the slope is severe enough that erosion would occur if all vegetation were removed. This is important for considering planting techniques. In general, slopes that are very long may erode even if the degree of slope is moderate. The erosion potential is also determined by the types of soil present. If you are concerned about this, you can get help from U.S. Soil Conservation Service (SCS) experts who help farmers and others determine the erodibility of their land.



Add uses, utilities, and other notes that are important design considerations.

19

Note the Slope's Aspect

The aspect of the slope is the direction it faces. A slope that faces south receives much more sunlight and is usually drier and harsher for plants than a north-facing slope. Certain plants have adaptations which make them more suitable for slopes of certain aspects, such as prairie plants for south-facing slopes.

Determine the Drainage of Soil and Site

Plants are adapted to certain moisture conditions. Some can tolerate wide ranges of soil moisture, others have more particular moisture needs. Your species selection will be limited to plants that will thrive under the moisture and drainage characteristics of the soil on your site.

Drainage will be determined by soil type or texture, slope, and other factors such as water sources. Water may be channeled into an area from the buildings or surrounding property. Drainage can be determined by existing vegetation, certain soil qualities, but also by simple observation. How long does it take an area to dry out in the spring? After a rain?

You may be able to find maps that show topography for your site, either from site plans or larger topographic maps available from the U.S. Geological Survey. USGS maps show very large areas but can be useful to see a generalized drainage pattern.

Map Existing Structures on and Adjacent to the Site

Existing structures will affect your planning either due to the shade, drainage, or wind patterns they create, or due to their stature and sightliness. Keep these points in mind:

Buildings—Map according to the same grid pattern established. Determine the shade pattern they cast.

Utility lines (above and below ground)—It is very important to locate any underground utilities before digging. You can do this by calling "diggers hotline"—a consortium of utilities who will come to your site within a week or so and mark with flags or spray paint any underground lines. Students would find it interesting to learn what is underground in the way of utilities.

Play or outdoor seating areas—Note existing or potential play and seating areas that will affect your restoration design. You may want to have a mowed or delineated seating area within your restoration. In this way, you can have students sit in the restored prairie while avoiding excessive trampling of the plants. Design some paths so that people must walk single file. This helps them more fully experience being in the prairie.

Sledding areas are not advised. The trampling and ice build-up would be detrimental to the plants.

Map Traffic and Usage Patterns

Note well-worn shortcuts or other traffic patterns to accommodate them on your plan. It usually makes sense to use patterns that already exist since habits are hard to break, and people usually take the most direct route to a destination. This does not mean that all your paths should be direct. The goal of paths within a restoration is not to provide direct routes to a destination, but to provide a feel for and teaching opportunities in the prairie.

Study the Soils of Your Site

Neil Diboll of Prairie Nursery has a thorough discussion of soils in the Prairie Nursery catalogue. We are pleased to include it here.

> Soils can be divided into three basic classifications: sands, loams, and clays. There is of course, great variation within these groups, but these categories will suffice nicely for the purpose of describing where a given plant will or will not grow.
>
> **Sandy soils** are referred to as "light" soils. Containing large sized soil particles, they are loose and easy to work. They allow water to drain readily, and tend to be low in nutrients. Sandy soils in general tend to be more acid

than the more fertile loams and clays. If your soil has a pH lower than 5, you should consider adding lime or wood ashes to bring it closer to a pH of 6.

Clay soils are commonly known as "heavy" soils. Consisting of very small, tightly packed soil particles, clays tend to be dense and hard to work. However, they are generally rich in nutrients, have a high water holding capacity, and can be very productive.

Loams are the ideal soil for all purposes. (some plants do very well in the other soil types). They are composed of a variety of different sized soil particles and combine fertility and moisture holding capacity with good drainage. They are easier to work than clays and better consolidated than sands. Loamy soils make an excellent medium for the growth of most plants. A large portion of prairie plants do best in these soils.

Determine Your Soil Type

It is sometimes difficult to distinguish between a loam and a sand or clay. Since a loam is intermediate between a sand and a clay soil, there are a multitude of intergradations (i.e., sandy loam, loamy clay, etc.) It is usually possible to differentiate between these three basic groups by the "feel test." Take just enough moist soil to rub between the thumb and fingers. Rub it back and forth several times. Feel it very carefully. A clay soil will be very slick and smooth, with little or no grittiness. A predominantly sandy soil will be very gritty and will not stick together well. A loamy soil will stick together easily, but not tenaciously like a clay. Loams feel moderately gritty. As the soil dries between your fingers, rub it into a dust and feel it carefully. A loamy soil will have a component to it that feels like flour. This is silt, an intermediate sized soil particle between sand and clay. Clays may also have a floury feeling to them, indicating silt content, but lack the gritty sand component found in a loam.

If you have difficulty determining your soil type by this method, dig into your soil when it is dry. A sandy soil will seldom exhibit clods. Any clods that do form will crumble easily.

A loamy soil will have clods, but these can be sliced cleanly and easily with a shovel. Clay soils tend to form hard, persistent clods. Rather than slicing through them, a shovel will get stuck or will shatter the clod into many hard, little blocks of soil.

If you are still in doubt, take a sample to your local county extension agent or a soil testing lab.

Soil Moisture

Soil moisture is an equally important consideration in deciding what to plant in a given area. As defined here, moist soils must have a generous amount of moisture available in the subsoil throughout the growing season. They may experience periods of standing water in the spring or fall. Dry soils include sandy and gravelly soils that drain readily. They never have standing water, even after a heavy rain. Medium soils, commonly called mesic soils, encompass well drained loams and clays. These soils will have standing water only for short periods after a hard rain.

One of the major factors that will determine how well your plants or seeds will grow is their compatibility with your soil. Each species has a certain range of soil types in which it will flourish. Some have wide ranges, while others have relatively narrow ones (Diboll, 1992).

Note Patterns of Shade and Light

Prairies need full sun for optimum growth. Many savanna species can tolerate partial shade, like that which is cast by oak trees. Shade cast by buildings is much different in that it is year-round and not mottled. Determine the shade patterns by observation and mapping or as a math exercise using the building height and the angle of the sun at different times of year.

Evaluate Your Views

There are views to protect and views to block as you consider your design. In most cases you will not be able to block all bad views. You can screen them, however, with well-placed shrubs or tall prairie species. You can also use color and

form to attract the eye, while distracting it from an undesirable view.

Good views and spaces will be those which give you the feeling of being in a prairie. Using curvilinear lines and paths will create a more natural flow to the planting and traffic pattern. A space looks larger if it disappears around a corner. Likewise, there is something enticing and mysterious about a path whose end is out of sight. Even a small planting can profit from creative curves.

Try to create a feeling of being a part of the landscape you are restoring. When you study a model prairie, choose the visual essence you wish to recreate. On most school sites you will not be able to restore a large prairie with hundreds of species. You will, in fact, be creating a prairie garden of probably less than fifty species. So make sure your species mix recreates the feeling of prairie. The section on species selection will discuss this further.

Rob Nurre, as the Surly Surveyor, explains the methods early surveyors used when laying out townships and sections. Historic role playing can be fun for students, too.

Research the History of Land Ownership

You can investigate the land tenure of your site through old plat books, title abstracts, and county histories. Many maps and old photos are available at state, county, and city/village historical societies.

Researching your site can take you on a fascinating tour through local history. Those events often parallel the history of the country—farms changing hands during bad times such as the late 1800s, 1930s, and so on. Often you can find diaries or reminiscences of what an area was like, if not the specific site, then at least the county. Students might interview older residents and unearth historical photos of the community and cultural events.

Once I was designing natural restorations for a park area that had been a Nike anti-missile site, a prison site, and farmland. I even found records from the 19th century prison and what the prisoners were fed. Mostly potatoes!

Examine Records of Presettlement Vegetation

The presettlement vegetation of Wisconsin has been determined partly through examination of the original land surveys done in Wisconsin during the 1830s and '40s. At that time, surveyors were hired by the government to lay out township and section lines so the land might be sold. They were to comment on the land as they walked it. Every time they set a post to mark the corner of a section or township, they used trees to "witness" the corner.

Townships are six miles on a side. Each township is divided into 36 sections one mile on each side. At every half mile along both the north-south and east-west lines the surveyors set a post. The location of these corner posts were described by locating nearby trees which the surveyors marked by removing bark to leave a "blaze" and noting the direction and distance to the post. If there were no trees, a post was set with small mounds of earth built up around it. As they walked the lines between the corner posts, the surveyors noted what the land was like.

For instance, I live on a farm west of Madison that was surveyed on Christmas day 1834. The witness for the section corner was a single "burr oak . . . no other. Land hilly and stony, third rate." This comment indicates the surveyor's opinion as to the quality of the land for crops. He was right.

This type of information is available through

the Commissioner of Public Lands located in Madison. If your property is along a section line, you and your students can find what was there in the 1830s. Some counties have this information interpreted in booklets available through the USGS. The vegetation of Dane County was examined in this way by Robert Ellarson in 1949.

Plant Community Selection

This publication presumes you are interested in planting prairie (or savanna). However, this is a reminder that the process of that decision hinges on more than the findings of your site analysis.

What existed presettlement is often a clue to what could be planted now, if conditions haven't changed too much. However, what could exist now might be different than the presettlement vegetation. This depends upon whether trees have grown up or been cut down, whether soil has been removed or otherwise altered, and the size and extent of the buildings compared to the planting site.

Take another look at your educational goals. It may be that prairie works best because of its shorter time frame than savanna. Then again, you might choose savanna because of its endangered status and the desire to work with such an ecosystem.

If you have a few large trees, you can consider savanna if the trees are mostly oaks and are widely spaced. (If your site has a lot of shade, then you should consider restoring a woodland.)

More than one type of plant community may be appropriate depending on the time scale and area available. Don't try to do too many community types in a small area (not more than one community on an acre or less). You could plan for a savanna in the future, even if you lack open-grown trees now. Begin by starting with herbaceous species common to both prairie and savanna. Then plant the oak trees. Years later, when the trees cast shade, you could add the savanna species adapted to low light conditions.

Prairies have their advantages. Much more is known about restoring prairies than is known about restoring almost any other of the native Wisconsin ecosystems. This body of knowledge may be something you wish to draw on rather than breaking new ground. Prairies need full or nearly full sun. They can occur on any soil type, but the soil type will dictate the species you use. In addition, prairie plants and seeds are less costly and more available in general than plants or seeds for other native communities.

By using plants native to your area, you are helping to restore not only the biotic diversity but the visual character of the Midwest. Prairies and savannas are as distinctive to the Midwest as spruce trees are to the north. Using plants native to your area helps to prevent the homogenization of the landscape.

Resource and Maintenance Considerations

Space

Evaluate your resources and limitations before starting your project. Our goal is to have teachers working with their students to do restorations. By working on small areas at a time, more students can participate over the years. I think that an area of 1000 square feet is a good size to start with.

If buildings or valuable trees cast too much shade for prairie because your site is small, you will have to consider savanna or woodland communities. If your trees are weedy species, such as box elder, remove them to plant your prairie.

Seed and Plant Sources

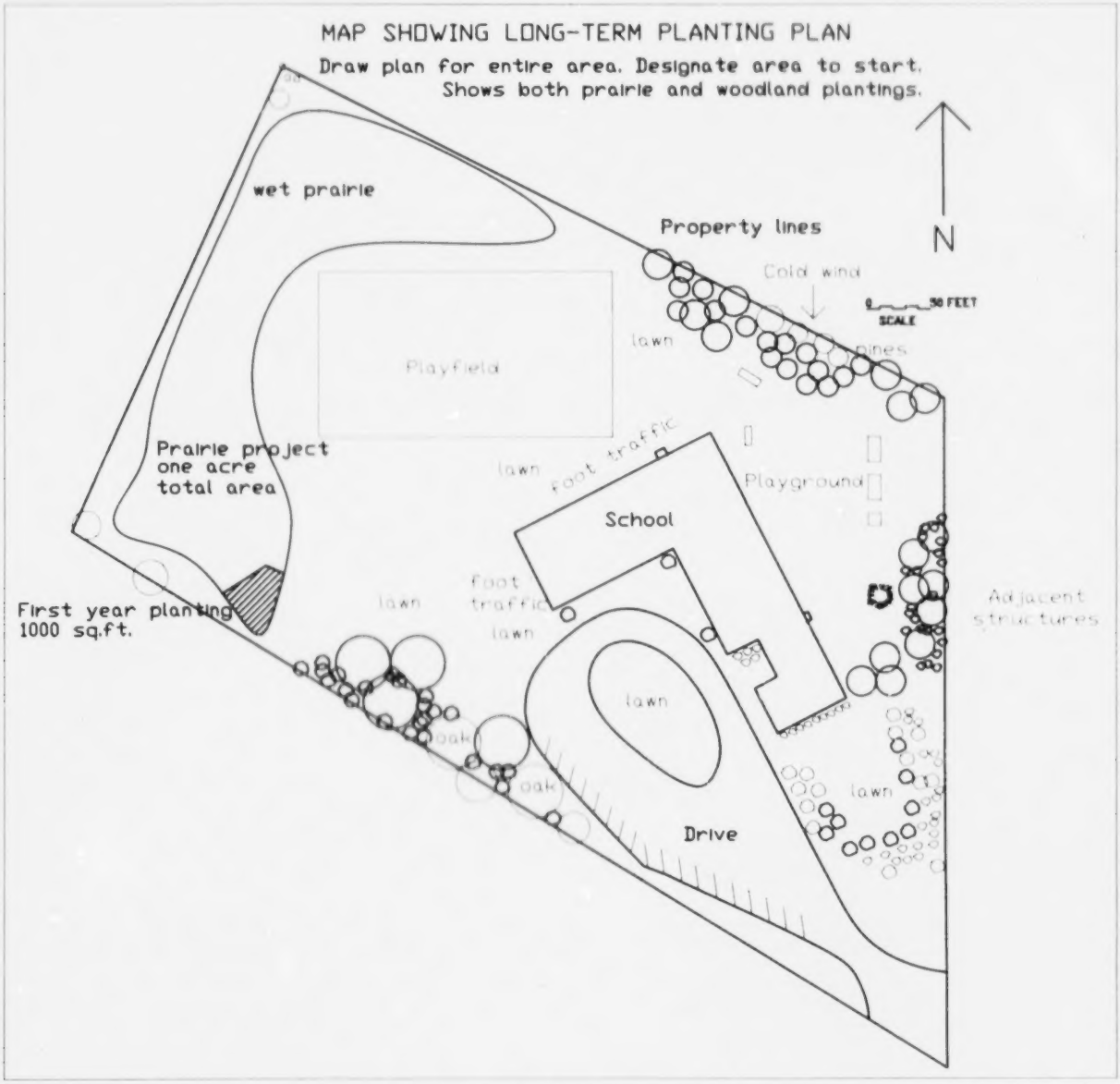
You will need sources for seeds and plants. There are many native plant nurseries which have seeds and plants for sale. You may want to purchase seed and start it in flats or containers and set the seedlings out in a nursery from which you can collect seed in the future.

Most experts recommend that seed for a planting be collected or purchased as close to the planting site as possible and from sites with conditions similar to the site to be planted. This is to

protect and preserve the genetic diversity of the plants by not swamping a local genotype with genes from another area. The genes of a plant from Nebraska, for example, are usually different enough from those of a plant in Wisconsin, even within the same species, because the plants have adapted to local climatic or other conditions. The general rule of thumb is to stay within a 50 mile radius of your site.

Do not collect *plants* in the wild. First of all, most wild plants do not survive transplanting. Many have very specific site requirements. In addition, some plants are becoming rare due to unethical collection. Wild plants belong to the land.

The only exception to this "no dig rule" would be to rescue plants that are doomed to destruction from construction or other disturbance. Even then, be sure that the destruction is truly imminent and not just a rumor. Check with local organizations such as the Wild Ones in Milwaukee or local nature centers to ascertain procedures, need for permits, etc.



Your final map should reflect site analysis and goals. Note the lawn buffers around the prairie. As you get into the restoration process, larger areas can be restored. However, be sure to save areas for future students.

You can obtain some of what you need through seed collecting field trips. You will need to obtain permission before collecting on any remnants. It can be a problem if too many people collect in an area or if seeds in an area are collected too often, so you need to use caution in arranging seed collecting forays. Some species you want on your prairie may set seed in summer. If you do not have summer classes that can collect the seed, you may need to purchase the seed from native plant nurseries (see Appendix) or obtain those species some other way.

Seed Collection and Storage

If you make arrangements to do so, your students can collect seeds in remnants, parks and the Arboretum. Be sure to clear species and amounts to be collected ahead of time with the person in charge.

Seed collecting begins in May with spring bloomers such as pasque flower and extends into late fall. Wayne Pauly, Dane County Parks naturalist, has created a list of seed collecting dates that you can use as a guide (see Appendix). Wayne collects seeds with hundreds of school children throughout the year for projects in the Dane County Parks and school grounds. The students get to be immersed in the prairie which is way over their heads in the fall, and hear fascinating folklore that Wayne has gathered over the years.

Seeds from plants that bloom early can be planted immediately into your site if it is ready before July 15. If the seeds do not dry out, they will germinate right away, often in a few days. If the seeds do dry, they develop **dormancy** that prevents germination until certain environmental conditions are met. Once dormancy develops, most seeds need to go through a cold spell (such as winter) before they will germinate. So if seeds are not planted immediately after collection, they need to be air dried and stored in rodent-proof containers. I store seeds in sacks (feed-type sacks are good) in metal garbage cans in an unheated building. This is called **cold stratification**.

Those seeds collected after mid-July are stored in a similar fashion. You can plant everything in late fall if your site is ready. The seeds will then go through a natural cold period that will break dormancy.

Some seeds germinate better if they are subjected to **wet stratification**. Seeds are mixed with damp sand or sawdust and stored in a cold place for up to 60 days. Many nursery catalogues and books listed in the bibliography give precise information about treatment needed for seed of individual species. Don't wet stratify seed if you will not be able to irrigate your planting. Wet stratification gets the seed ready to germinate. Drying out at that point could harm or kill the plant embryo.

Time

Prairie restoration is one of those things in life we take one step at a time. Ideally, your students will be restoring the site with you. Given enough area, you could plan on many years of planting. A prairie takes several years to develop. Typically perennial, most prairie plants do not flower the first year they are planted. Prairie plants spend most of the first year developing a root system designed for surviving drought. Some species, such as black-eyed susan and yellow coneflower, will flower by the second year. Some of the grasses may also flower the second year. A prairie planting often does not look like a prairie until the fifth year after planting. A lot depends on weather and how effectively weed competition has been controlled.

Teamwork and Support

Most importantly, you need the support of other teachers (preferably a team within the school), administration, maintenance staff, and neighbors. Prairie plants spend much of their initial energy on creating their fantastic root systems, so flowering waits until the plant is established during the first few years after planting, and everyone involved needs to be educated to that fact. Patience and vision are needed to endure through the rough beginnings.

Maintenance Requirements

The first two years of a planting require mowing of certain weeds such as ragweed, lambsquarters, velvet leaf, and fall panicum every few weeks to re-

duce their competitive effects and prevent seed production (see lists prepared by Cathy Bruner in the Appendix). This should be carefully planned so the restoration does not get mowed as part of the lawn, thereby avoiding confusion and conflict when the time comes for mowing to cease. Once again, this is a reason to involve the maintenance personnel in the planning process.

Neighborhood Acceptance

Ideally, parents and neighbors will join in the restoration and establish some prairie gardens on their own property. This could follow their learning with your students about the restoration process and an awareness and appreciation of the prairie community.

Design your planting to mitigate effects on neighbors. Have mowed lawn adjacent to neighbors' lawns. Plan especially showy plants for neighbors' views. Tell them to expect a couple of years of rough-looking plantings but show them pictures of the species you are planning to plant. Point out that prairie plants are perennials that take a long time to establish. Also point out that prairie plants are not weeds that either homeowners or farmers have to deal with, so you aren't creating a host ground for pests to invade their lawns or gardens.

Equipment Needs

Depending upon the size of the restoration, you may need access to some mechanized equipment. A rototiller is labor-saving when working up the ground prior to planting. A mower helps to control weeds the first two years (set those blades up at least six inches!). Mowers can also be used to maintain paths. Look to area businesses or parent support networks for possible use of their machines.

Costs

Costs will vary according to your abilities to collect seed and start seedlings in flats or containers. Professor Evelyn Howell has had students plant seeds in milk cartons where they grow over a season and then are stored dormant over winter in a barn or garage. The next spring, they are transplanted.

Some species like prairie dropseed, pasque flower, and birdsfoot violet show poor germination or survival rates when planted directly into the restoration plot. If you are unable to start them indoors, it is best to purchase them as transplants. These can cost anywhere from less than a dollar to several dollars, depending upon the nursery and type of plant you buy. Plants that are grown to landscape size in a nursery are more expensive than seedlings grown in pots. A general seed mix to cover 1000 square feet cost around $60 in 1992.

You may want to use many approaches—some purchased plants, some purchased seed, and some seed that you and your students collect. This way you can get the best mix of plant species and experiences for the students.

Other costs may include mulch to kill the existing vegetation on your restoration site, if necessary. Costs of rototilling and mowing should be figured unless equipment and labor are donated. You may have to resort to use of herbicides if mulching isn't feasible for some reason. This can be very expensive and of course not something the students would participate in for safety reasons.

Study of Plant Community Model

Locate a good remnant natural community as close to your site as possible. You may find them through the Department of Natural Resources (DNR), Nature Conservancy, Wisconsin Prairie Enthusiasts, Wild Ones, or other groups that have been instrumental in identifying and saving remnants. Be sure to get permission to study or use the site. Some sites may be too fragile to tolerate much use. Visit a site with students and learn together which species exist and how they are distributed throughout the area. While the Arboretum's communities are restorations, they are also worth visiting and can be used as models.

Here are some of the things you and your students can do to get to really know the prairie.

Aesthetics

14 15 Get an overall feeling for the essence of the community. As discussed previously, every prairie is different, but you will be able to get a general idea of the ratio of grasses to forbs and the relative abundance of species.

Remember this simple rule—grasses dominate. Notice how they form a matrix of textural background for the forbs. A mistake often made in prairie gardens is to not include enough grasses to provide this aesthetic characteristic of prairies. Without grasses, it just doesn't look like a prairie. Without grasses, the forbs often have rank growth and aren't contained in a pleasing way.

Some species are represented by only a few plants but are very important visually or to the functioning of the system. Note such uncommon species. Find out how many species of nitrogen-fixing legumes exist there. Map the occurrence of visually dominating species such as prairie dock.

Visit many times a year to see how the community changes. Prairies begin the year with showy flowers on low-growing plants like pasque flower, prairie smoke, and blue-eyed grass. As the season progresses, taller and taller plants flower above the surrounding vegetation. One advantage to this is that the flowers can easily be seen by insect pollinators. You will want to duplicate this seasonal variation by choosing a mix of species that will flower throughout the growing season.

Adaptations

16 Get to know prairie plants and the adaptations that make them well-suited for survival. Native plants remain resistant to diseases and pests that evolved with them. Native plants that have co-evolved have also developed ways to survive each other's competition. For example, through varying blooming time, stem height, and root length and type, prairie species coexist, filling every niche of available space and time.

Prairie plants evolved together in a world of temperature and moisture extremes, wind, intense sunlight, and fire. Adaptations make it possible for them to conserve water and withstand drought, while thriving on all that sunlight. Just compare a blooming prairie in August with a dormant, brown bluegrass lawn, and you will see the advantages the naturally evolved adaptations have given the native plants.

Diversity

18 Study the diversity of the prairie. Look closely at a small area of the model. Use string in a circle or four sticks to mark an area of a square yard or square meter quadrat. Count how many different species of plants are in the quadrat. You do not need to know their names to see that there are different plants. You can also notice how many grasses there are compared to plants with broad leaves. If something is in flower, you can identify it using an identification book such as *Wildflowers and Weeds* by Courtney and Zimmerman. Use information from a few quadrats such as this to get an idea of how many grasses to plant compared to forbs, and how many plants grow in a quadrat area.

11 An interesting exercise is to do similar quadrat studies in a lawn, old field, or pasture and then compare the numbers of species present. If you compare these areas with a natural prairie, the natural prairie will have by far the most diversity. Maintaining this diversity is one reason for doing restorations and saving species.

Interdependence

19 Study birds, insects, frogs, mammals—any living thing. Information on grassland birds collected by the DNR recently shows a sharp decline in many species. You could contact the DNR Bureau of Research for more information. Many observers have been helping the DNR conduct frog surveys to determine the health of frogs in Wisconsin over a long period of time and a wide area. Many species spend much of their lives in upland areas. Frogs may be good early indicators of problems in aquatic systems and the uplands around such systems. Riveredge Nature Center in Newburg, Wisconsin, has started a study that seeks to find out more about the relationships between prairie plants and invertebrates. Such information

is important to restorationists, and students can often contribute data to these long-term studies.

Species Selection and Design

Whether the recreated or restored habitat is several acres in size or a ten-by-ten-foot isolated landscaping project, planting native species that have evolved together in a community makes natural sense.

On your site map, outline the area(s) to be planted and the type of community appropriate (mesic prairie, dry prairie, savanna, etc.).

Select the species you want to plant from a list for your model community. You can also use lists in *Vegetation of Wisconsin* by John Curtis or lists in other books or nursery catalogues. Be sure to choose species whose natural range includes your site. Range maps developed by the DNR which show where plants naturally occurred are contained in the Appendix.

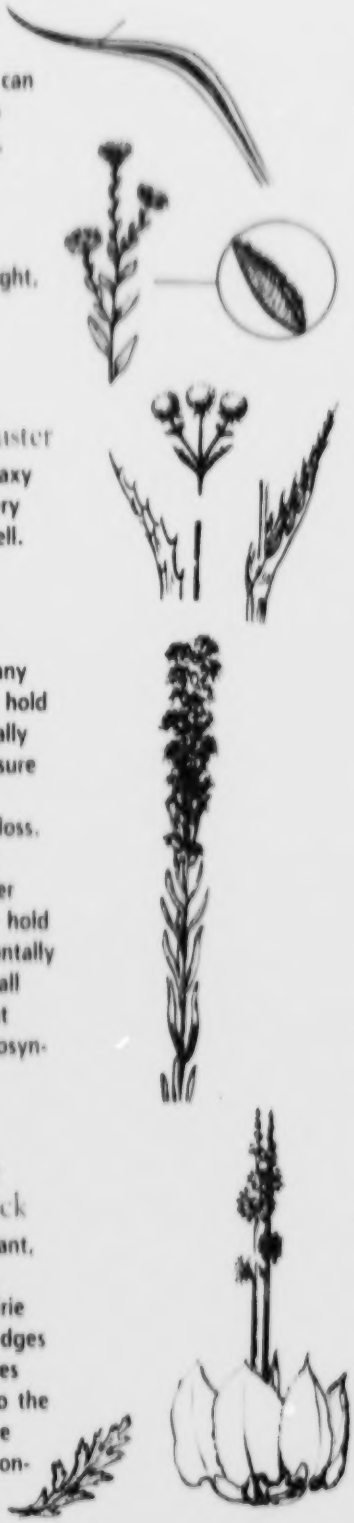
Choose those species suitable for your site as determined by its soils, slope, drainage, and aspect. Certain species cannot tolerate wet feet—pasque flower is one. Certain others such as pale spiked lobelia cannot compete well on good soils with the more robust species that are found there.

Design Criteria for Species Selection

1. **Botanical Model**
   a. grass-to-forb ratio
   b. plant family (grass or legume, etc.)
2. **Visibility and Visual Essence**
   a. occurrence (numbers and distribution)
   b. maturity rate
   c. time of bloom
   d. height
3. **Plants to Avoid**
4. **Plants to Add Later**
5. **Diversification** (see page 34)

To create a list of species that will fulfill these criteria, you will need a minimum of fifteen species of forbs and three species of grasses. Recall

Plant Adaptations



Indian grass

Leaves of grasses can roll length-wise to conserve moisture.

Silky Aster

By reflecting sunlight, tiny hairs retard evaporation.

Rattlesnake Master

Leaves that are waxy or stiff and leathery retain moisture well.

Liatris

On the prairie, many herbaceous plants hold their leaves vertically to maximize exposure to sunlight while minimizing water loss. In contrast, many plants of the cooler maple forest floor hold their leaves horizontally to capture the small amount of sunlight available for photosynthesis.

Compass Plant and Prairie Dock

17

Compass Plant, and closely related Prairie Dock, orient the edges of their huge leaves north and south so the broad surfaces face away from the noontime sun.

that grasses are most numerous in number of stems, but fewer species are involved. This grass matrix is not only ecologically sound, but it also gives visual unity to your planting. Include forbs that will flower throughout the year, although you may concentrate more heavily on those species that will bloom during the school year. Don't neglect summer blooming species though, especially if your prairie is visible to a neighborhood or street. A natural prairie would have many more species than eighteen, of course. You can plan to add species as you expand your planting area or as your planting matures. In the Arboretum, the sixty-four acre Curtis mesic prairie has 200 species. Your area will probably be much smaller with many fewer species.

Botanical Model

Big bluestem and Indian grass are important components of tallgrass prairie. However, when planted as part of a seed mix, they tend to dominate. This represents an example of the knowledge gained in recent years of restoration research. Formerly, seed mixes contained 80% grass seed by weight, because that reflected the dominance of grasses seen on remnants. Now, recommendations are for around 50% seed by weight because they will fill in over time. In fact, experts have recently been using even fewer than 50% seeds of these species in the initial planting, then adding more seeds after other species are established (one to three years). Other grass species are not aggressive and can be planted with the initial seeding.

20 When selecting forbs, be sure to include some from the major plant families important to prairies: daisy, legume, rose, milkweed, parsley, and mint. Visually, they add variety and interest to the planting. They are also important for the health of the planting and its value to wildlife.

Visibility and Visual Essence

Refer back to your impressions of the prairie model to determine the pattern and occurrence of visually important species. For instance, just a few butterfly weeds have a strong impact when in bloom. Other species grow in patches, like lupine, making a splash by sheer numbers.

Early blooming species such as pasque flower should be included at a school site.

Your list should include some fast-maturing pioneer species that will help hold soil and provide early interest: yellow coneflower, bee balm, black-eyed susan, ox eye sunflower, asters and goldenrods, Canada wild rye.

Also include species that will take longer to mature and bloom: pale purple coneflower, rattlesnake master, flowering spurge, blazingstars, butterfly weed, prairie clovers, silphiums, spiderwort.

According to Neil Diboll, some species exhibit very slow growth and will not reach maturity until after four or five years. His list includes leadplant, false indigos, New Jersey tea, shooting star, goatsrue, compassplants, lilies, gentians, culver's root, and prairie dropseed grass.

I recommend that you include spring bloomers because they will flower during the school year. Plan for some of these species to be placed near paths or seating areas so students can see them more readily. Keep in mind, however, that collecting seeds for these species is tricky. The seed pods of birdsfoot violet and downy phlox explode when ripe, catapulting their seeds into the air. Blue-eyed grass and yellow star grass are hidden by the prairie by the time the seeds are ready to collect. It helps to flag the plants when they bloom so you can find them later. You may want to plant these species as seedlings or purchased plants.

By late summer on the tallgrass prairie, the grasses and forbs that are in flower can reach six to eight feet high. You need to remember this when you are selecting species and designing your

planting. A planting of this height may not be appropriate in small areas. Safety issues may dictate smaller species where visibility is important.

Plants to Avoid

There are some native species you may want to exclude from your list. Those species that could pose a health hazard, such as poison ivy, are obvious. Some species can be overly aggressive in initial plantings. These include common goldenrod and giant and sawtoothed sunflower.

Some forbs can also be overly aggressive if included in large numbers in your initial seed mix: sunflowers, tick-trefoils, bergamot (bee balm), black-eyed susan, common and whorled milkweed, dogbanes, ox eye sunflowers, and coreopsis. But they should not be excluded (Diboll, unpub.).

Plants to Add Later

Some species do not germinate and survive well in a new planting: prairie dropseed, purple prairie clover, shooting star, Culver's root, alum root, gentians, and lilies. In most situations, plants that are difficult to germinate in the field can be added as seed after a burn a year or more after a seed mix is planted over the entire area. An alternative would be to add them as transplants. Note these species on your plant list, and designate areas for them on your planting map.

Other Design Considerations

Some prairie gardens are planted entirely with plants, but this is an unnecessary expense in larger areas. It is usually done by homeowners who want a quick prairie. (Prairies started from seed take two to five years to look impressive, which is too long for some people in a front yard situation.) Prairies planted this way are planted with one plant per square foot of planting space. Over the years, these plantings will fill in. However, it is difficult to achieve a totally natural randomness to such a planting.

If the soils vary over your site, you may want different seed mixes which should be noted on your map. You may wish to increase the number of showy forbs on part of the planting which will be viewed often either from the school or neighbors.

Locate trails, seating areas, buffers, and firelanes on the map before planting. Try to create trails that meander through the planting without straight lines, but don't cut up the planting into pieces too small to give a feeling of being within the prairie. You will probably not plant all of the site at once, so you can plan your trails for access to the planting as it evolves.

Most experts recommend that initial plantings not be too large to handle, but large enough to give a feeling of what a prairie can be. I think a planting of at least 1000 square feet is necessary if it is on a large lawn or old field site. A planting smaller than that is apt to be overwhelmed by the old field or lawn.

Respect the fact that neighbors may not appreciate prairie, and keep your planting away from the edge of lot lines. Mow the area adjacent to neighbors' lawns so the transition to the prairie is not so abrupt at the lot line.

In the end, you will have a plan that should designate areas for planting over time, a species list for initial and subsequent plantings, and management plans.

Lawn buffers and curving lines blend prairies with other types of landscaping.

Site Preparation

Proper preparation of your site is probably the single most important factor in the success of your prairie planting. The type of site preparation you

A Special Note About Remnant Prairies

If you have discovered native plants living on your site, you may be working with a prairie remnant. This is both exciting and challenging for your planning. Some native species are relatively common and do not indicate a quality remnant. These include common milkweed, old field goldenrod, and even bee balm.

However, if your site has several native species or species less common such as prairie dropseed, blazing stars, or species of legumes, then you are dealing with a higher quality remnant that deserves special care. Avoid any activity that would destroy the remnant such as broadcast spraying or tillage. Many remnants can be restored simply by burning. Biomass growth and flowering of forbs increases following burns. In addition, many nonnatives are reduced by burning.

After burning a remnant, see what returns naturally before going to great efforts to add species. Many species that have been dormant or hidden for many years will reappear after fire. After several years of sampling the remnant after burns, you can determine what to add to increase diversity of the area. Planting seed on the bare spots after a fire is a good way to add species.

(A word of caution: Some non-natives can be a problem if burns are scheduled too regularly. See page 33, "Long-Term Management," for a discussion of burning.)

will need to do depends on many factors including the type of existing vegetation, budget, time, and safety and ethical concerns about the use of herbicides. You also need to consider who will do the planting and when.

Time your site preparation to coincide as closely as possible to planting so that the weeds from the lawn or old field cannot invade. Mow around the outside to provide even more buffer from weeds.

Guidelines for Site Preparation

1. Identify Undesired Plants

For prairie restorations, these include woody species, non-native perennials, and annual or biennial weeds.

Woody species are incompatible with prairie because of the shade they cast. Even native woody species such as sumac, aspen, willow, and dogwood can pose problems for prairie restorations. These plants are woody pioneer species whose "job" is to invade open land and prepare the way for the forest. They are adapted to fire as are the prairie species, so they cannot be removed by fire management of the prairie. Before prairies were confined to small remnants, there was a constant give and take between the prairie and woody plants for pieces of ground. But now that prairies are isolated islands, we cannot allow the invasion of the woody species to take place.

Non-native perennials are common in lawn or old field situations. Although bluegrass is not a native species, it does not pose as much of a threat to a restoration as quack, brome, orchard, or other grasses because it is reduced by fire over the long haul. The presence of the other non-native perennials requires their removal prior to planting the prairie.

Annual weeds and weed seeds will be a part of any prairie planting. Their role is to colonize bare ground which you will be creating if you till the soil. They do not pose long-term threats to the prairie planting unless they come in so densely as to create a lot of shade or a lot of protest by neighbors or district employees. The number of annual weeds you get will be determined by the number of weed seeds in the soil "bank" waiting for the opportunity to germinate.

2. Remove Undesired Plants

Woody Species

Cutting and herbiciding—To remove undesired woody species (as discussed above), you can try several techniques. You can cut them and treat

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Teachers use elbow grease and tools to remove buckthorn and honeysuckle from a savanna site.

the stumps with herbicides, or you can cut and recut as they resprout (another natural adaptation). Sumac can be controlled by repeated cuttings during the summer over a two year period.

Herbicides applied to freshly cut stems are transported to the roots which are then killed. Consult with your local garden center or farm store for the herbicides they would recommend.

Girdling—Aspen is another story. Here, girdling the stems is proving to be more effective. At the Arboretum we use a car leaf spring sharpened on one end for large stems and a broken off, sharpened table knife for small stems. The tools help break and remove an inch-wide strip of the outer bark and tissue from the entire circumference of the tree. This disrupts the flow of products of photosynthesis (via phloem tissues) from the leaves to the roots. The xylem, which draws products from the roots, is left undisturbed. Eventually, the roots are starved, and the stem dies.

Aspen and sumac are both clonal species. What looks like a grove of many aspen trees may actually be one with many stems. This is why cutting some of them does not work, because those left standing will send up more sprouts. Even cutting all stems may fail because there is so much root storage that new stems will emerge.

"Weed wrench" or mechanical removal—Some small trees and shrubs can be removed mechanically by pulling unless you are in an area where mechanical uprooting might harm other plants. Weed wrenches are tools made by New Tribe Company in Oregon which use leverage to aid in uprooting plants.

Non-native Perennials or Annuals

Mulching—Lay down newspapers or black plastic covered by wood chips or compost at least two months of growing season prior to planting. You can do this the fall before a spring planting (in September) or the spring before a fall planting.

Mulching takes time but is effective in killing off existing vegetation. It does not eliminate annual weeds but can be used in conjunction with tillage of germinating weeds or with no-till planting.

Tilling—Multiple tillage can be used on a site with minor weed problems. Till the area every few weeks for at least one growing season to kill the existing vegetation and the seeds that germinate from the seed bank. This does not always eliminate all the perennial weeds which are able to regenerate from root segments.

Annual weeds and their germinating seeds can be reduced by tilling the site six weeks before planting, then again two weeks after the first tilling, then just before planting. This allows the annual seeds to germinate, then kills them before they flower and set seed. Any annuals that germinate after the prairie is planted can be reduced by judicious mowings (see the management section).

Herbicides—Use glyphosphate herbicides to kill perennial weeds by spraying them when they have grown six to eight inches tall. Follow label instructions.

If you do use herbicides, wait two weeks after

Teachers try four methods of site preparation. Shown here is plastic mulch covered with wood chips.

application to till so you can see the success of the herbicide. If the herbicide was not entirely successful and you are dealing with persistent perennial weeds, make a second application of herbicide to finish the job. Wait two more weeks and till again.

Sod removal—Bluegrass sod may be stripped from a small site. Follow with tilling three times as above for weed seeds prior to planting.

Burning—You may also plant into bluegrass after burning if bluegrass is the only non-native grass present. Allow the bluegrass to get long enough the season before planting so that the dead tops will carry a fire in the following spring. The bluegrass will persist in the prairie but should not be a severe problem. Use this technique if you do not want to till or otherwise open the soil to erosion.

3. Improve Soil If Needed

After you have eliminated unwanted species, you are ready to prepare the seed bed for planting. Determine if enhancement or amelioration of the soil is necessary. You can choose species appropriate to the soil type and avoid the need to alter the soil. Even very sandy soils have species appropriate to them that will thrive and do not need the addition of topsoil.

If your site has been highly degraded by either chemicals or construction, has lost all topsoil, and consists of mostly raw clay, it will not be hospitable to plants. Adding topsoil or organic matter will be very important to improve this soil environment. Topsoil can be purchased but often contains weeds which will require appropriate measures for control as described above.

Add organic matter to clay soils by piling on composted material or planting "green manure" crops. Prairie Nursery recommends "buckwheat in rotation with winter wheat. These crops improve the soil by bringing up nutrients from the lower soil and converting them into plant organic matter. They are then plowed under while actively growing, incorporating the roots and leaves into the soil." (Diboll, 1992) Do this for a year prior to planting. Till under the winter wheat four to six weeks prior to planting.

4. Prepare the Seed Bed

Just before planting either in late spring or fall, till or disk the soil. Then rake or drag it to break up large clumps of dirt. The seed bed does not have to be as fine as for a lawn, but you do want the seeds to be able to make contact with the soil.

Planting and Management Planning

Planting Techniques

There are different planting techniques to choose from for establishing your prairie. This could include a combination of a seeding technique plus using transplants.

You can plant small areas by handsowing seed. I have planted as much as half an acre by this method without help. I recommend hand broadcasting even larger areas while working with students. This is a time of celebration and satisfaction for all the work done to this point.

To plant by hand, you will need roughly 20 pounds of seed for an acre of land. Divide this in half after mixing all species together. Add an equivalent amount of slightly dampened sawdust or sand and mix it with the seed. Sow the seed by walking over the *entire* planting area with each half of the seed and scattering it in a broadcast fashion. With the second half of the seed, walk in a different pattern or direction in order to get a random sowing of the seed without missing many spots.

21 Involve the students in organizing the broadcasting in such a way that no major area lacks seed. After sowing the seed, rake the area or dance on it (really!) or both, to insure that the seed is in firm contact with the soil.

Students will enjoy examining the different seeds with their beautiful variations in form, color, and texture. Different seeds have different appendages which are part of their dispersal mechanisms such as the lacy parachutes on asters, blazing stars (liatris), milkweeds, and goldenrods.

Many restorationists have adapted farm equip-

ment for planting prairies. These are used mostly on large acreage. Two types are used—a Truax drill and a Brjllion seeder. The drill lays down the seed in rows by drilling a row with a small "chisel", dropping the seed, and then pushing soil over the seed with wheels. The Brillion seeder drops the seed on the prepared ground and has spiked rollers for pushing the seed down and compacting the soil.

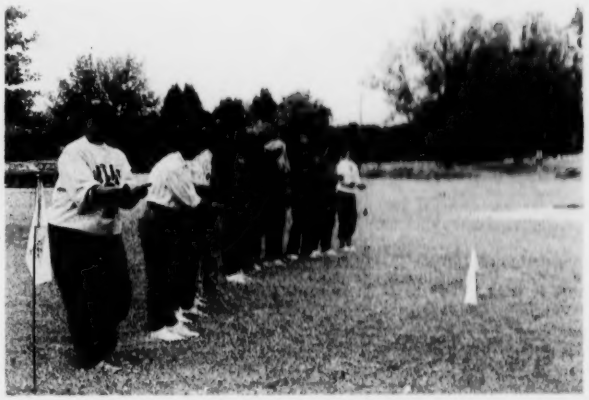
You could combine handsowing with mechanical raking of the soil by using a drag behind a tractor, or a rototiller set no deeper than one-half inch to incorporate the seed with the soil after sowing.

You may want to add some transplants to your planting, either seedlings that the students have grown, or plants obtained from nurseries. Do this to add species that are difficult to grow in the field from seed, such as prairie dropseed, and to add flowering interest to the planting more quickly than waiting for the seeds to germinate and mature. Many of the spring flowers are good to add this way such as pasque flower, birdsfoot violet, and phlox.

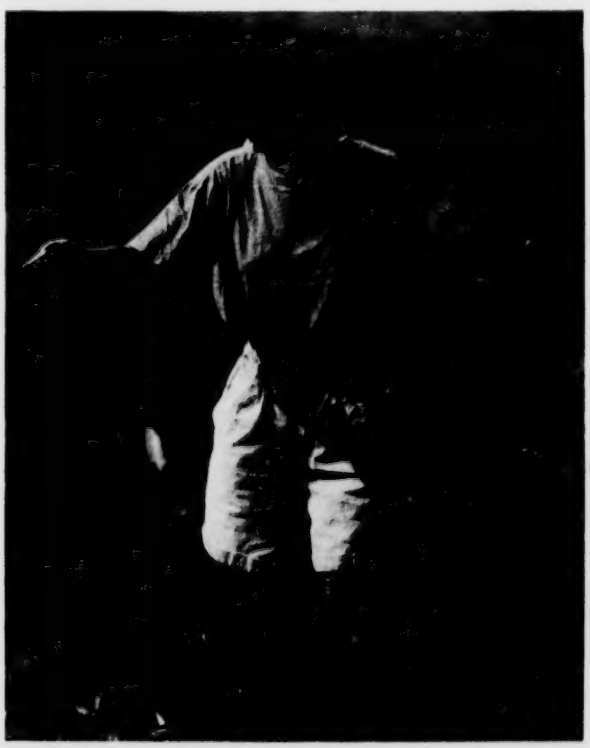
It is a good idea to start a few seeds in flats as representatives of the seed you are sowing in the field. In this way, you can begin to recognize the seedlings. This is especially important if you are considering any hand weeding of the site. I don't generally recommend hand weeding over mowing, but if you have a small area in a prominent place, you may want to consider this.

Your planting can coincide with the time farmers are planting corn (May) and later into the summer. Of course if the students are planting (and they should be), you will plant before the second week of June unless summer school classes are involved. Many restorationists delay plantings into late May so that they can control early season annual weeds or have time to complete site preparation. This time of planting may favor grass seed germination, and you may want to decrease the amount of grass seed in ratio to forb seed when planting at this time.

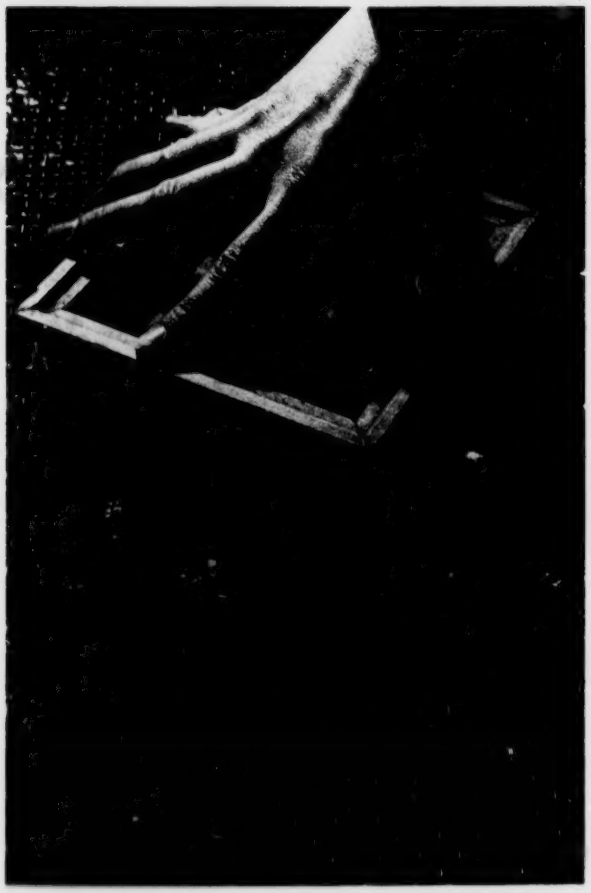
Don't plant from mid-July to late September, because the seeds might germinate without having enough time for the seedlings to prepare for winter.



Above: Teachers line up to spread seed across a plot. They use half of the seed for this pass.
Below: Individual species or drifts of showy plants can be hand-sown on top of a general seed mix which covers the entire plot.



You can plant in late fall if your site is well prepared. Fall plantings do best on sandy soils which have fewer problems with spring weed germination. This is when many of the seeds are ripening and falling anyway and saves you from having to store seeds over winter.



Use screens of different sizes to clean seeds. Rub the collected material between screens to remove everything but the seeds. The other plant material can be sown on the site, too, and can serve as a mulch.

Planting Rates

In general, restorationists strive for a seeding rate that will give at least 40 seeds per square foot of area. Rough estimates have traditionally been to plant 20 pounds of seed per acre if you are hand broadcasting the seed. The rate of 40 seeds per square foot can be figured with purchased seed because the nurseries know how many seeds per pound there are for each species they sell. You then decide what general ratio of species you want. Most experts now recommend planting 50% grass seed by weight and 50% forb seed by weight.

The seed should be cleaned as much as possible. If you have collected seed, clean it by rubbing the seed head over screens and winnowing it with fans or a light breeze outdoors (a good history lesson). At least separate the large pieces of chaff from the seed heads. Be creative! Don't throw away the separated material. Plant it with the seed in case you have missed seed in the cleaning process. You won't need to do this with purchased seed if you buy from a reputable nursery. If the seed you purchase contains a lot of non-seed material, you should return it and purchase from a different nursery. Some plant identification books have illustrations of the seeds also and might be useful here.

If you are planting with seedlings or transplants, figure one plant per square foot of area. Try not to plant in rows or a grid, but use the general amount of area to figure the plants you need. Again, try to have a 50-50 ratio of grasses to forbs. Place the plants randomly instead of in masses of the same species as is done in perennial gardens.

In the Arboretum prairies over the last 50 years, some species, such as compass plant, have stayed exactly where they were originally planted. Others, such as prairie dock, have spread readily. Some species, including sunflowers and goldenrods, form clones.

Short-Term Management Considerations—First Two Years

Annual weed control is recommended for success of the planting. You can mow the site after planting when the weeds get above six inches in height. Mow them at six inches. Don't let them get too tall, or they will shade out the prairie seedlings. Try to prevent seed formation by mowing just after the annuals flower. You will probably have to mow three times the first year. Sometimes the weeds can mature very quickly, especially if there is a rain after a dry spell. Because of this, you will want to have someone monitor the site over the summer to time the mowings correctly.

During the second growing season, you may have to mow once or twice. After that, maintenance should be restricted to occasional controlled burns and monitoring the site for any significant weed problems. Watch out for sweet clover, wild parsnip, leafy spurge, and reed canary

grass. These can be more easily controlled if detected early.

I have started prairie plantings without mowing with mixed success. One site has thrived. Another was shaded badly by an annual panic grass and still is suffering four years later, although it is starting to look like a prairie now.

Long-Term Management Considerations—Fire

Fire is a natural process that prairie species have adapted to over thousands of years. Fires were started by lightning and ran until a river or other natural feature stopped them. Native Americans used fire to clear the way for early spring growth of prairie grasses to attract grazing bison and elk. They may also have used it as a weapon in hunting and war. It is speculated that they used fire defensively or to clear areas around their camps for better visibility and for their own safety from fire.

Scientific studies show that the main benefit from fire is the removal of the heavy layer of dead material from the surface of the soil. The sun can then reach the blackened soil and warm the surface. The biomass produced by the plants above ground can nearly double during the year after a fire. Most prairie species show significant increased blooming after fires. Blooming decreases in proportion to the number of years since a fire.

Wayne Pauly's booklet, *How to Manage Small Prairie Fires*, is an excellent resource for understanding how to use fire for management. It details considerations for a successful and safe burn. Once your plan has been approved by your school administration, be sure to find out if you need a burning permit from the local fire department.

Don't burn the prairie at the same time of season in successive years. That could be detrimental to early season flowers when burns are always conducted early. Problems with biennial weeds such as sweet clover increase under a burning program that burns every other year in April. In areas of the Arboretum where there is a sweet clover problem, the burning schedule is an April burn one year followed by a May burn the next. The April burn stimulates sweet clover seed to germinate. The next year's later burn eliminates the flowering and seed set of the second-year plants.

If you are unable to burn the prairie, you can accomplish much of the same effect by mowing it and raking off the dead material. This technique is less effective in controlling non-prairie species such as quack grass and bluegrass, but it is better than nothing.

There are woody plants that are natural pioneers of the forest that invade prairies. However, fire or mowing prevents them from gaining a foothold into the prairie as seedlings. If they are already established on or adjacent to your site,

In March, a controlled burn in the Arboretum blackens the prairie.

By July, the same site shows the remarkable growth of the prairie with the grasses reaching over six feet tall.

you will need to aggressively control them as mentioned previously. If you have a remnant with a significant woody problem, you can use the herbicide or girdling techniques described earlier.

Many people are starting to consider the introduction of other natural processes into prairie restorations. There are many animals native to the prairie that disturb the ground by digging, pawing, or grazing. This would allow those prairie species that need open ground in order to germinate seeds to continue to reproduce in the restoration. These species include prairie pioneers such as black-eyed susan, yellow coneflower, and partridge pea. Some of the low-growing prairie species, such as the prairie violets mentioned by Laura Ingalls Wilder, also benefit from openings.

Diversification

22 As your prairie matures, you can still add species that you were not able to plant at the beginning. Plant by seed in bare spots immediately after mowing or burning. You may add seedlings or transplants at any time.

Your prairie will attract many butterflies and other flying insects. Introducing animals and insects that can't fly in is a new area of consideration for prairie restorations. Much research will be done in the next few years to inventory restorations and prairie remnants to see what insects may be lacking in restorations.

The Human Element

1. Decide who will plant the site (students, preferably).
2. Decide when the site will be planted (spring or fall).
3. Determine where you will obtain seed (purchase, or gather and clean).
4. Work with the person(s) who will manage the planting the first year. If a custodian will do the mowing, he/she should be in on the planning process, planting, and any inservices or workshops so he/she appreciates and feels connected to the prairie the way you and your students do.
5. Look ahead to determine who will monitor the site for unusual problems.
6. Tend to public relations and community education. Wayne Pauly, Dane County Naturalist, who works with prairie restorations intensively, strongly recommends a large sign and a definite edge for your prairie so that neighbors and parents know what is going on. You could hold workshops or slide shows for parents and community members to teach them about the prairie and the restoration process (see *Prairie Curriculum Sampler*—"Celebration Activities").

23

PARTING WORDS

In June 1992, Greg Bisbee returned to the Arboretum. It was Thursday of the second restoration workshop. Teachers were working hard pulling honeysuckle and buckthorn and weeding the previous year's restoration. Greg shared his story. He and Michelle were able to teach students about the history of the land around their high school. Rob Nurre, the "Surly Surveyor," re-enacted the 1834 survey of their site and described the vegetation and the site as it appeared at that time (see Appendix for list of resource people).

Teachers dance on site to press seed into soil and to celebrate a prairie birth.

Students explored the history of the property before and after the time of the survey and designated an area for their prairie restoration. They also collected seed, started the seed in the greenhouse, and set the plants out in the spring. Other teachers started asking about the project and how they could get involved. They are off to a successful start.

This is one example of how restoration-based environmental education can work in a school. Language arts (creative writing, journaling), literature (Cather, Wilder, Frost), history (local, oral, land tenure, pioneers, Native American), art, physical education (pioneer games, Native American games, physical gardening activities), math, sciences, agriculture . . . all integrated through the act of restoring the land and our connection with it.

In *The Island Within*, Richard Nelson talks about this kind of connection:

"What makes a place special is the way it buries itself inside the heart, not whether it's flat or rugged, rich or austere, wet or arid, gentle or harsh, warm or cold, wild or tame. Every place, like every person, is elevated by the love and respect shown toward it. . . . My hope is to acclaim the rewards of exploring the place in which a person lives rather than searching afar, of becoming fully involved with the near-at-hand, of nurturing a deeper and more committed relationship with home, and of protecting the natural community that sustains all who live there."

As you sow the seeds of the prairie, you also sow the seeds of hope that ecological restoration gives us. People, wherever they are, can learn to live with the land and heal the wounds caused by past misunderstandings. Restoring the land demonstrates the love and respect that enriches it, and us, through the diversity and beauty of the native landscape.

REFERENCES

Courtney, Booth and James Hall Zimmerman. *Wildflowers and Weeds*. New York: Van Nostrand Reinhold Co. 1972.

Curtis, John C. *The Vegetation of Wisconsin*. Madison: University of Wisconsin Press. 1959.

Diboll, Neil. Prairie Nursery Catalogue. 1992.

Diboll, Neil. To be published: chapter on species selection in book on restoration of Midwestern prairies. Edited by Bud Nelson and Steve Packard. Available in 1993.

Ellarson, Robert S. "The Vegetation of Dane County, WI in 1835." *Transactions of the Wisconsin Academy of Science Arts and Letters* 39:21-45.

Jordan, William R. III. "Earthkeeping: A Realization." *Restoration and Management Notes* 8:2. 1990

Jordan, Gilpin and Aber. *Restoration Ecology*. Cambridge: Cambridge University Press. 1987.

Leopold, Aldo. *A Sand County Almanac*. New York: Oxford University Press. 1949.

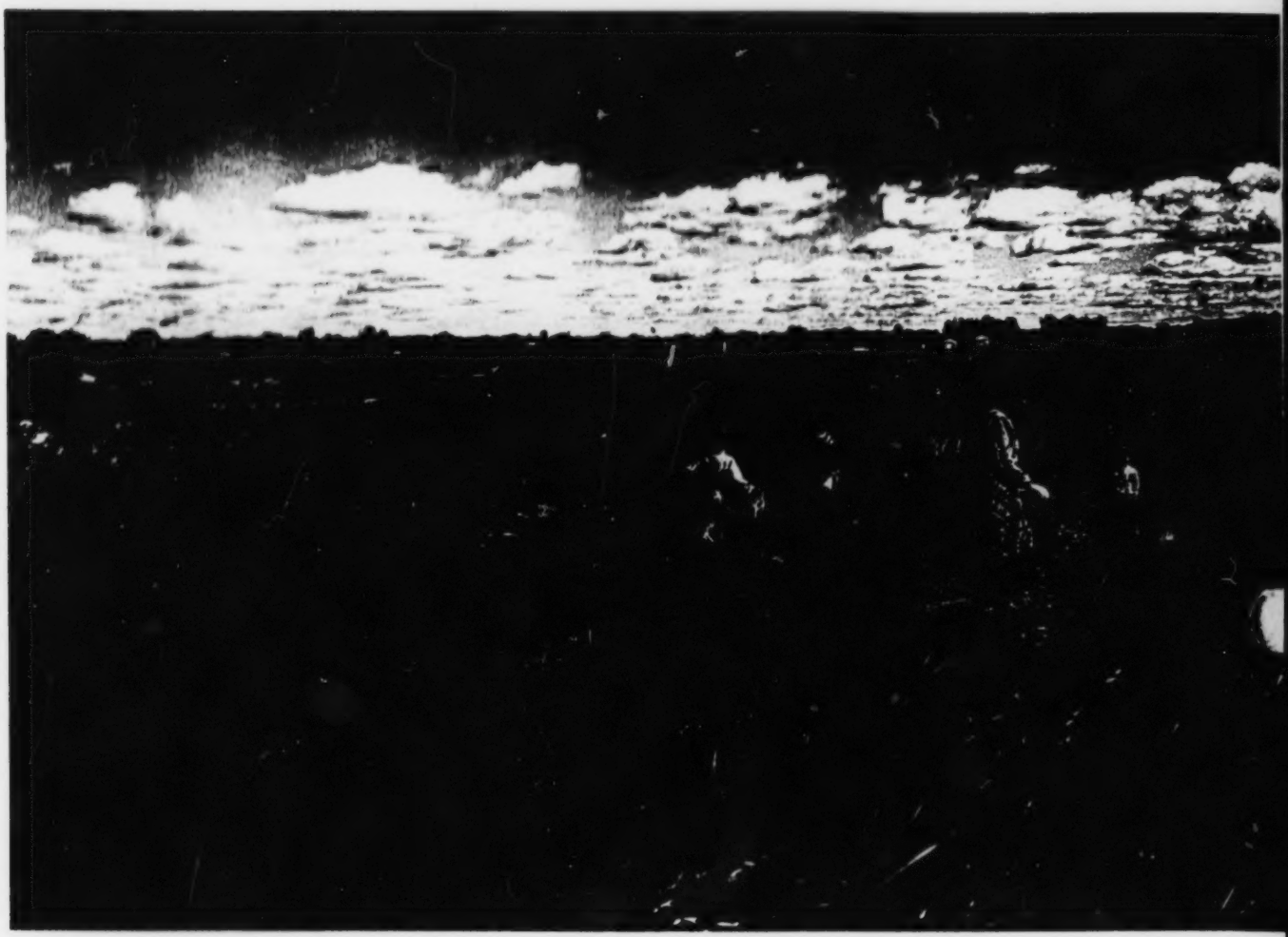
Morgen, Kathleen. *Prairie Curriculum Sampler*. University of Wisconsin–Madison Arboretum. 1993.

Nelsŏn, Richard. *The Island Within*. New York: Vintage Books Edition, Random House. 1989.

Packard, Steve. "Just a Few Oddball Species: Restoration and the Rediscovery of the Tallgrass Savanna." *Restoration and Management Notes* 6:1. 1988

Pauly, Wayne. *How to Manage Small Prairie Fires*. Dane County Park Commission. 1982.

Wilder, Laura Ingalls. *By the Shores of Silver Lake*. New York: Harper and Row. 1939.



From the Earthkeeping Program at the
University of Wisconsin–Madison Arboretum

A PRAIRIE ACTIVITY GUIDE

By Robin McC. Greenler

From the Earth Partnership program
at the University of Wisconsin-Madison Arboretum
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Introduction

Philosophy

Restoring an ecosystem can be a transforming experience. It transforms both the practitioner as well as the land. Biologically, ecosystem restoration can begin to conserve habitat, rare and endangered species and biological diversity. It can begin to recreate an ecosystem that once dominated but has now been destroyed through human impact. But this is only a fraction of the transformation that can occur. As we explore this rare opportunity to interact with the land in a positive way, we begin to develop a personal relationship with it. And in that personal relationship, we are transformed.

With what, exactly, are we developing a relationship? The land that we live on holds our history; as we plan an appropriate restoration we find ourselves delving into the history of the land. That history is our history. It is the history of our people and their dreams, choices, and accomplishments that sets us into our present-day society. The land that we live on also defines our present day. The land affects us, limits us and has the potential to inspire us in ways we may not know. Finally, as we develop a personal relationship with the land, we are looking into our future. We are making conscious choices about how we want to live and what we want to value.

Restoring native ecosystems on a school site provides a tremendous opportunity for teachers and students. As students begin to form an awareness about and positive attitude toward the natural community, they begin to develop the skills necessary to identify, investigate and thoughtfully consider environmental dilemmas that they will face as adults. Edward Cheskey, in the introduction to Habitat Restoration: A Guide for Proactive Schools, states:

> *Restoration is perhaps one of the most important actions that we can do as educators to prepare the future decision-makers in our society to face the environmental and ecological challenges that await us. Habitat restoration at a manageable scale can contribute to a generation of nurturers and healers that have the knowledge, skills and values to address greater societal issues.*

The benefits of restoring a native ecosystem on a school site are not simply philosophical. Restoration can involve students in exciting, hands-on, action-oriented projects. Through direct involvement, students take part in the planning, preparation, planting and management processes. Students have the opportunity to ask questions, make observations, and learn through first-hand exploration. As restoration is such a young discipline with such huge potential, students may be seeking answers that are not known and asking questions that have not been asked.

When engaged in a genuine "exploration" the journey will, by necessity, be interdisciplinary. As students plan and carry out their restoration, they will make decisions based on biological, economic, political, social, technological, cultural and aesthetic considerations. This can bring the restoration into all classrooms at all levels.

Overview of the Activity Guide

This Activity Guide is a sampler of some of the activities that a school can use as it embarks on a prairie restoration. We have tried to give a sense of how the restoration process can be used across grade levels and many subject areas. The Scope and Sequence categorizes the activities in the guide according to grade level and subject. Activities cover grades K-12 and subjects of science, math, language arts, social studies, art and music. Each activity described in the Scope and Sequence is contained in the Activity Guide. In each activity, relevant subject areas are noted. Those subjects noted in boldface indicate primary emphasis.

Every teacher knows how overwhelming it can feel to add one more thing onto an already overloaded set of responsibilities and overfull curriculum. Realizing this, we have presented these activities as sketches that individual teachers can adapt and expand to help reach their own educational objectives. While it is unlikely that a teacher will teach restoration solely for its own sake, restoration is a powerful vehicle that can encompass a wide range of concepts at all levels. Areas and subjects already being taught can be enhanced, illustrated and integrated with a restoration focus.

As the goal of these activities is often not acquisition of a specific body of knowledge, evaluation may prove challenging. However, many of the activities lend themselves to an evaluation that can assess the awareness and skills gained. The prairie journal can be an excellent means for self- as well as external evaluation. In addition, teachers can evaluate based on richness of dialogue, discussion or brainstorms, oral presentations, research reports and public impact.

The activities in the guide are intended to reinforce and supplement the information and suggestions for student involvement in the UW-Madison Arboretum publication Prairie Restoration for Wisconsin Schools. The restoration handbook outlines basic background information about Wisconsin prairie communities and guides teachers through the process of creating successful prairie plantings with their students. Activities in this guide often presume familiarity with background contained in the handbook, and such background material is not generally repeated in the activities.

Material for this activity guide has come from many sources. Often the ideas came from other teachers, although tracing the absolute genesis of an idea is often impossible. The person listed as the source for each activity is the contact person for that

activity; he or she might have created the activity completely, modified and passed on an idea gathered elsewhere or simply be the best person to contact with more questions about the activity.

The Activity Guide is organized into the following seven units:

Prairie Definition and Introduction
Human Habitation and Cultural History
Prairie Plants
Prairie Insects, Birds and Mammals
Ecosystem Interactions
Restoration
Integrative Activities and General Strategies

For those who would like to enlarge their background knowledge, a bibliography of prairie resources is included in the appendix to Prairie Restoration for Wisconsin Schools. Teacher restoration workshops are also available through the University of Wisconsin-Arboretum. For more information, write the Outreach Program Manager at the UW-Madison Arboretum, 1207 Seminole Hwy., Madison, WI 53711.

Background

Prairie Definition and Introduction

Prairies are grassland communities of plants and animals with characteristic soils, climates, populations and species diversity. Prairies are dominated by grasses with a smaller, but important, population of other non-woody, flowering plants called forbs. Prairies are often defined as grasslands with less than one mature tree per acre and at least 50 percent of the cover made up of grass or a grass-like species. Prairie-like ecosystems with more than one tree per acre but less than 50 percent tree cover are termed savannas. Full sunlight, long days and warm temperatures during the growing season are critical to the establishment and continuation of the prairies.

At one time, prairies dominated much of the central section of the continent from east of the Rockies to Indiana (see Appendix 1, "Prairie Boundaries in the United States"). Short-grass prairies in the drier western region gradually gave way to wetter mid- and tall-grass prairies as one moved toward the east. Before 1830, much of southern Wisconsin was tallgrass prairie or savanna. Wisconsin was on the border between midwest prairie and eastern forest.

Cultural History and Human Habitation

The first people entered the North American continent twenty to forty thousand years ago from Asia across the Bering Straits. Over this treeless passage, animals such as elephants, bison, deer and bear also entered the continent. Early people gradually developed from a flint-tool culture to the early prairie culture of hunting, trapping and gathering. These prairie hunters lived a nomadic way of life, following animal migrations and the seasonal ripening of plant foods.

In the thirteenth century, a terrible drought on the prairies wiped out most of these traveling grassland hunters. Slowly the prairies became repopulated. By the sixteenth century, soon after Columbus first came to the New World, hundreds of tribes of Indians lived on the American prairies. Most lived in villages, their livelihoods based on farming, seasonal hunting and gathering. Their agriculture included growing maize, beans and squash as well as using native berries, nuts, fish, birds, river mussels, turtles and game animals for food (Costello, 1969).

Some Indians, most notably the Sioux, lived nomadic hunting lives. While they hunted small game and gathered food from plants, their lives were largely centered on the bison. In different ways, many Native American tribes lived in and with the prairies, their lives and livelihoods intertwined with the prairie ecosystem.

Because it was very difficult to navigate in the tall prairie

grasses and plow through the deep roots of the prairie plants, the prairie was not settled as quickly as other areas of the continent. Many of the prairie lands were thought to be barren wastelands that could not support even forest vegetation. However, settlement of the prairie, while initially slow, inexorably changed this resilient, rich and complex ecosystem into monocultural crop land and low-productivity grazing lands that dominate the area today.

The conquest of the western short-grass prairie, first started by grazing, was ultimately concluded by the plow. The first domestic grazing animals entered the prairies in large numbers in the 1600s. Coming north from Mexico and west from the East Coast, cattle and sheep made dust beds out of much of the prairie. Railroads in the mid-1800s stimulated the cattle trade and brought large numbers of people to the prairie region.

The eastern tall-grass prairie met its demise largely under the plow, first applied to growing wheat and, later, corn for dairy cows. The development of the steel plow starting around 1837 allowed settlers in both the short- and tall-grass prairies to more easily cultivate and plant some of the most fertile soil on earth. While the harsh prairie climate and droughts of the late 1800s slowed prairie settlement, excessive grazing and poor cultivation practices continued the ecosystem destruction.

Increased grain and livestock demands from World War I, coupled with newer plowing, terracing and irrigation technology, rapidly increased the prairie acreage put under cultivation. Very quickly much of the prairie ecosystem was transformed into fertile agricultural land (see Appendix 2, "Corn, Wheat and Grain Production in the United States"). In the process, however, most of the prairie ecosystem was eliminated. At that same time, rapid urbanization of the eastern plains region was destroying the prairie through physical use of the land and suppression of fires critical to the maintenance of the prairie vegetation. Many of the plants and animals that once lived in the prairies are now rare or endangered.

The agricultural boom of the early twentieth century was harsh on the land. While rich prairie soil produced abundant crops, this soil, which had been built up over millennia, was being rapidly depleted. Nutrients were used and not replenished and soil texture was destroyed, contributing to water and wind erosion problems. The dust bowl of the 1930s vividly displayed the tremendous damage wrought by careless cultivation practices. While conservation methods following the dust bowl have helped to a small degree, current agricultural practices are still depleting the once-rich prairie soil at a rapid pace.

Prairie Plants

Prairies are dominated by grasses and grass-like sedges. These plants account for 50 to 90 percent of the plant cover but only a

few species are represented. A large number of forb species, each species present in small numbers, can account for 80 percent of the total number of species on a prairie site.

The large number of species living on a prairie is partially a result of plants adapting to harsh environmental conditions of scarce water, intense sunlight, strong winds and high temperatures. These conditions have led to numerous water-conserving plant adaptations such as folded or rolled leaves, hairiness on the leaves and stems, upright or rotating leaf orientation and waxy leaf coating.

Prairie plants compete with one another for sunlight, space, nutrients, seed dispersers and pollinators. In addition, the plants rely on one another for functions such as shade, wind protection, nitrogen fixation, reduction of soil moisture evaporation and attraction of pollinators. In this way, the prairie ecosystem is tightly interdependent with plants, animals, soil and climate exerting both positive and negative influence on one another.

Most prairie plants have extensive root systems. Up to two-thirds of a prairie plant's mass is underground. This compares to 50 percent for typical lawn grass and 20 percent for trees. This adaptation helps prairie plants survive severe droughts, fires, harsh winters and grazing.

Prairie Insects, Birds and Mammals

Insects on the prairie are a vast and varied group and range from the common to the extraordinary. Their presence is important to survival of all other living creatures on the prairie as they play a dominant role in pollination and decomposition and are often an early step of the food web. Pollinating insects will travel to flowers in search of nectar. At the same time they are transporting male pollen to the female parts of the flower. In this way, immobile plants can efficiently cross with one another. The flowers' main purpose for an insect-pollinated plant, therefore, is to advertise the nectar rewards available to a pollinator. Decomposing insects, many of which reside in the soil, are critical to the cycling of nutrients in the ecosystem. While not obvious, the numerous species of decomposers, many of which are insects, provide the basis for a functioning ecosystem.

The prairie can also provide habitat for many birds and mammals including meadowlarks, sparrows, bobolinks, shrews, moles, bats, prairie dogs, rabbits, chipmunks, squirrels, foxes, wolves, coyotes, badgers, lynx, bobcats, elk, deer, moose and bison. The animals interact in unique and complex ways.

The Prairie Ecosystem

In order to avoid intense competition and to adapt to weather cycles, prairie plants have different seasonal periods of growth,

flowering, pollination and seed dispersal. As a result, we can experience a changing vista of colors, scents and textures throughout the prairie year. The best-known and most dramatic sequence involves the prairie plants blooming from mid-May through mid-October; as one blooming plant wanes, another takes center stage. These sequential, or phenological, changes are dramatic, somewhat predictable and easily observable.

Plants and animals interact extensively with one another on the prairie. In some cases, the interactions are beneficial to both organisms, such as a bird eating berries and dispersing the plant's seeds. In many cases, the interaction benefits one organism and harms the other, such as a hawk eating a shrew or a broad-leaved plant shading out a smaller one. Mutually negative interactions also occur; for example, as two plants grow close together they can crowd one another's root systems and prevent either from obtaining sufficient water. Interactions can occur between two plants (such as moss growing on a tree trunk or a large plant serving as a wind break for a smaller, more fragile one), between plants and animals (such as an insect pollinating a flower or gnawing on a leaf) or between two animals (such as an insect laying eggs on a large animal's dung or a bird eating a slug).

The food web is a set of interactions that involve the transfer of energy and nutrients from one organism to another. Observable links in the prairie food web include decomposers in the soil, herbivory of plants (the primary producers) and predation of one animal by another (don't forget the insect animals!). The prairie's extremely high primary production, the rate of plant matter production per acre, has perhaps contributed to its complex and rich food web.

Prairie soil is exceptionally rich and fertile. This fertility is largely due to prairie plants' extensive root systems. The broadly branched roots and deep taproots slough off and regenerate approximately 50 to 80 percent of their root mass annually. This root matter adds a tremendous amount of organic matter to the soil, creating high soil fertility. In addition, many prairie plants are legumes that contain bacteria in root nodules. These nodules fix nitrogen from the air that would otherwise be unavailable for plant use. When these legumes die, the nitrogen is also released into the soil.

Because of their deep root systems, prairie plants can easily survive loss of their above-ground stems, leaves and flowers. In fact, periodic disturbances that destroyed the above-ground portion of the plants were critical to the establishment and survival of the prairie ecosystem. Periodic fires, which favored the deep-rooted prairie plants and discouraged invading trees and shrubs, regularly swept through the grasslands and helped fend off invading woodlands. Today, fire remains an effective management tool in combatting invasive weeds in favor of native prairie plants. Grazing by large animals such as bison was also critical to the prairie ecosystem. Prairies in Wisconsin that are kept from burning, grazing or mowing generally change to woodland.

Prairie Restoration

Across the Midwest, people are trying to restore small areas of prairie on land that hasn't supported a prairie ecosystem for 50 to 150 years. We can probably never fully replicate a true prairie ecosystem; they are far more complex than we can comprehend. In addition, the natural creation of prairies took millennia and many of the organisms that once called the prairie their home are now rare or endangered.

So why restore small plots of land at all? In doing so, we begin a healing process for the prairie land, we learn about the prairie community and the natural processes that rule it, we provide a safe haven for rare species, we create an enjoyable natural space and we help to restore a healing and natural balance to our earth. Restoring a prairie is also tremendously valuable in demonstrating a model for humans to interact with nature in a positive way.

Each step involved in restoring a prairie provides excellent opportunities for learning. As the ultimate goal is student learning, we urge you not to rush through the educationally rich planning stage. It's important to savor and learn from the process rather than rush toward the product. An established prairie is attractive; however, a rich and robust educational program must be the educator's primary goal.

The following paragraphs briefly outline the steps involved in prairie restoration. Consult the booklet Prairie Restoration for Wisconsin Schools for a far more detailed discussion of the restoration process before beginning any restoration project.

Planning

The first step in designing a prairie restoration is to conduct a site analysis, including researching the current human uses and site history, determining the plant and animal populations that live there, soil types, light, slope and slope aspect. Human uses to consider include existing buildings, traffic patterns and utility lines. A site history could include pre-settlement vegetation and the history of land ownership and use. The site history gives an important context to the process of restoring a historic ecosystem. It can also give students a stronger "sense of place" about the community in which they live.

After making a site analysis, carefully assess your available resources and needs. Consider where, when and how you plan to obtain seeds, how and who will maintain the prairie annually, what equipment needs you have, and how you can bring together an enthusiastic team of supporters including school teachers, administration, maintenance staff, students and neighbors. The money available for the restoration effort will bear on many of these decisions. Include students in these consideration as much as possible.

Finally you and your students need to select the plant species

for your restoration. If possible, visit a local prairie remnant or older restoration to serve as a model. Keeping in mind factors of diversity, aesthetics and site conditions, you will want to mimic the array of plants in a natural prairie as closely as possible.

Site Preparation

Preparation of your site includes identification and removal of undesired plants such as woody species, nonnative perennials and annual weeds. Slow the growth of woody species by cutting or girdling them or eliminate them by mechanically uprooting or applying herbicide. Non-woody annuals and perennials can be eliminated by mulching, tilling or applying herbicide. After eliminating unwanted species, you will need to prepare the seed bed for planting. Immediately before planting, the soil is generally disked or tilled.

Planting

There are several different ways to plant your prairie, including sowing seed by hand, drilling seed in mechanically or planting transplants.

Management

Your prairie will need some ongoing maintenance and care. The first growing season you will want to mow the prairie a few times. This will prevent weeds from shading out prairie seedlings and prevent the weeds from setting and dispersing seeds later in the season. The second season the prairie will need mowing once or twice. After the second year, the prairie benefits from being burned in the spring every one or two years. If a burn is impossible, mowing and raking or haying the dead material is a good alternative.

Again, do not rush the restoration. The goal is learning and involvement, not an exact biological composition. Students can be fruitfully involved in almost all phases of the process.

Reference

Costello, David, F., The Prairie World, New York, Thomas Y. Crowell Company, 1969

Activities

I. Prairie Definition and Introduction

Don't Get Edged Out

Source: Robin Greenler
Subject: **Math, science**, language arts
Grade: 6-12
Summary: As remaining prairie remnants become smaller, "edge" prairie becomes the norm and "interior" prairie becomes rare. Students calculate and compare the percentage of a prairie remnant that could be considered "edge" to that considered "interior" and study the ecological implications.

Activity Time: Mapping the remnant: 30-60 minutes plus travel time. Calculations and discussion: 60 minutes.
Materials: tape measure
Season: any

Activity: In a natural area, the habitat at the edge of the area's boundary is very different ecologically from its interior. The edge of a prairie can differ from its interior with respect to temperature, relative humidity, penetration of light, exposure to wind, insect populations (many insect populations will move based on temperature or light), availability of pollinators and seed dispersers, success of seed dispersal, competition from exotic species, suitable animal habitat and soil organism populations. If the majority of our remaining natural prairie is in small remnants, there will be more "edge" habitat and less "interior" habitat and the proportions of various species will be modified.

Defining how far the edge extends into the prairie is difficult. The definition of an edge depends on which factors one is examining. If one examines the differences of ant dispersal at the edge versus at the interior, the edge may be defined as 10-30 centimeters. Edge effects of shade on a prairie bounded by forest may extend 30-70 meters while the effects on wind pollination may extend the edge definition to 100 meters or more. But regardless of the number, interior prairie habitat is becoming increasingly rare.

With your students discuss the difference between an area at the edge of a remnant and one in the middle. Visit and map a prairie remnant. Upon your return, calculate what percentage of the total acreage is within 10 meters of the edge. (You may use another figure if you like; this one was intended to take in many of the environmental factors listed above and some insect pollination and dispersal factors). What would the percentage of edge habitat be if the area was the same total area but square? What if it were square and 100 times the size? 1,000 times the size? If we used a figure of 100 meters for "edge," what would be

the edge and interior portions in your prairie?

Extension:

* Have students consider why prairie remnants are valuable and what role they play in restorations.
* Using quadrats, survey and compare plant species found at the edge of the prairie remnant and those found in the center. See the activity entitled "Grasses and Forbs: A Prairie in Balance," for more information on surveying plant species with quadrats.

Grasses and Forbs: A Prairie in Balance

Source: Robin Greenler
Subject: **Science, math**
Grade: 6-12
Summary: Students examine the balance between grasses and forbs and look at different ways to measure the amount of each represented on a prairie.

Activity Time: 1 hour minimum; must be done in a prairie
Materials: sets of four equal-length quadrat sticks, approximately 30 cm
Season: summer, early fall

Activity: Prairies are generally defined as open areas with at least 50% grass cover. However, while grasses or grass-like species form 50 to 90% of the cover, generally only a few species form this matrix. Forb species, each present in small numbers, can account for up to 80% of the total number of species on a site.

When visiting a prairie remnant or restoration, divide students into groups and give each group four sticks of equal length so they can set up a square in the prairie. Have them randomly choose a spot for their quadrat by throwing an object over their shoulder to identify the quadrat center or have them choose a spot that they consider to be representative of the prairie.

Within their quadrat have them estimate (a) the percentage of cover of grasses and of forbs (all green, non-grass plants) and (b) the number of different species of grasses and forbs. For part (b), they need not identify the individuals but only the number of different species. It may help if each group assigns their own names to plants ("short fuzzy," or "lace-leaved thick stem") to help them count species. If there is time, each group may survey two or three quadrats.

Compile class data. Calculate the percentage of grasses and forbs in the prairie by cover and by number of species. How do these numbers conform to the definition of prairie?

Extension: Students can conduct a parallel survey for other grassland types such as old field and lawn, other ecosystems such as woods and wetlands or human-designed areas such as a park, agricultural field, botanic garden, flower garden or vegetable garden. See activity "Take a Look: An Elementary Biodiversity Study."

Is this Prairie Weather?

Source: Robin Greenler
Subject: **Science,** social studies
Grade: 3-12
Summary: Students keep climatological data for their restoration site.

Activity Time: variable
Materials: high/low thermometer, rain gauge
Season: all year

Activity: Keep your own climatological data including daily highs and lows and precipitation. How does this year compare with an "average" year with respect to rainfall and temperature? Good local weather records and statistics are available from the Wisconsin State Climatologist's Office at (608) 263-2374. Teachers from outside Wisconsin can get the appropriate contact for their states by calling the Wisconsin office. Consider what weather information might mean for your prairie restoration.

In his book The Vegetation of Wisconsin John Curtis states that Wisconsin mesic prairies have, on average, a total annual precipitation of 31.3", average January temperature of 15.9 degrees F, an average July temperature of 71.8 degrees F and a growing season of 152 days. Given the climate data for your site (both this year's data and long-term averages), what type of prairie or prairie site do you think you have?

What is a Prairie Climate?

Source: Robin Greenler
Subject: **Science,** social studies, math
Grade: 6-12
Summary: By examining the climatological data from prairie and non-prairie regions, students determine which climatological factors are necessary for a prairie to establish and survive.

Activity Time: Researching climate information: 1 hour. Analyzing data: 30 minutes.
Materials: references containing climatological data for the United States
Season: any

Activity: Obtain climate data from prairie areas such as Iowa, northern Texas, and eastern Montana and from non-prairie areas such as the northeast, southeast or southwest. Examine factors such as total annual rainfall, monthly rainfall and monthly high/low temperatures. Additionally, examine the hours of sunlight during the growing season and total length of the growing season. By examining the data, determine which climatological factors seem critical for the survival of a prairie. Graph the data to make similarities and differences more obvious.

Who Am I?

Source: Kathleen Morgen
Subject: **Science, language arts**
Grade: 3-8
Summary: Students state what they know, think and feel in order to clarify their values and establish a basis for measuring change in awareness, knowledge and commitment.

Activity Time: 40-60 minutes
Materials: none
Season: any

Activity: "There are some who can live without wild things, and some who cannot....[I am] one who cannot."
Aldo Leopold, A Sand County Almanac

Begin with a discussion of the above quote by Aldo Leopold to find out what kind of wild things the students really care about. Model a response by asking them to complete this statement: "One wild thing I cannot live without is...." Have them explain why they feel this way. Compile a list as the students share.

Explain that wild things live together in communities and that often entire communities are disappearing. One such community is a prairie. Find out what students know about the prairie by having them share any single words that relate to some aspect of the prairie. Write these across the board randomly. Next, ask them to find two words that relate to one another and share how they relate. Draw a line between these two words. After many connections have been made, ask them to identify a pair of words that have no relation to one another. If a pair is suggested, challenge the class to come up with a meaningful connection for that pair. Explain that as you work together restoring a prairie site, your knowledge of the prairie and its interconnections will grow.

II. Human Habitation and Cultural History

Celebrating a Prairie Year

Source: Robin Greenler
Subject: **Social studies, art, music**, science
Grade: K-12
Summary: Students consider the basis for our holidays and rituals and design a prairie celebration.

Activity Time: 1 hour minimum
Materials: none
Season: any

Activity: As a class, make a list of all celebrations and rituals we perform that are connected to the land. Which natural events recur each year that we might celebrate? Make a list of prairie events that occur annually. Design a celebration or activity that might mark a prairie year. Involve the music or art teacher in the celebration.

Global Grasslands

Source: Robin Greenler
Subject: **Social studies, language arts, science**
Grade: 6-12
Summary: Students research other grasslands around the world and compare them to the prairies, both biologically and in terms of their human history.

Activity Time: variable
Materials: resource materials
Season: any

Activity: Have students research other grasslands in the world. What are the biological differences and similarities between these grasslands and prairies? What is the history of habitation, use, protection and destruction in these areas? In what ways is that history similar to and in what ways is it different from the history of human interaction on our prairies? What can we learn from these histories?

Extension:
* Write an imaginary letter to the editor of a newspaper in a country with a grassland similar to our prairies. Tell the readers of our prairie history and warn them of what could happen to theirs (or write a letter from their country to ours warning us what could happen).
* Write an imaginary letter to the editor from someone in the United States in 1850 warning about possible consequences of plowing the prairie.

Life on the Prairie

Source: Robin Greenler
Subject: **Language arts, social studies**
Grade: K-12; younger students may create their own accounts by dictation.
Summary: Students read accounts of Native Americans or early prairie settlers and then write their own fictional accounts.

Activity Time: variable
Materials: early accounts from Native Americans and settlers (see bibliography)
Season: any

Activity: Many accounts exist of Native Americans and early prairie settlers. The literature addresses students from K-12, and can be read aloud to the class, excerpted or assigned as individual reading projects. Have students spend time in a prairie or prairie restoration. Between their personal experience and reading accounts of others, have them write their own fictional account of the prairie. See the bibliography for a list of appropriate literature.

Extension for grades 6-12:
* After reading impressions, accounts and journals of early pioneers and Native Americans, write a fictional journal of a Native American or settler living on the prairie. Describe, from their perspective, their daily life, challenges, hardships, joys, fears, and hopes for the future.
* Write a letter from a new settler "back home" describing the prairie.

Natural Dyes

Source: Denise Jess
Subject: **Science, social studies, art,** language arts
Grade: K-12; when working with younger students, avoid using any plants that are toxic.
Summary: Students work with prairie plants to make their own natural dyes and dye their own cloth.

Activity Time: Dyeing the cloth: 30 minutes. The full project including research, gathering, preparation and dyeing may take several days.
Materials: bleached muslin, large cooking pots, alum, paintbrushes, dye plants from list below, books and field guides on dye plants and prairie plants (a good one is North American Dye Plants by Anne Bliss, Charles Scribner's Sons, New York, 1980).
Season: late spring, summer, fall

Activity: There are several starting points to this project based on available time, students' skills, interests and available facilities.

Research Have students research which prairie plants work well for dyeing, what parts of the plants should be collected and whether the plant can be picked or if it is protected. If you do not wish to have the students do research, below is a list of prairie plants suitable for dyeing.

Aster	Big Bluestem	Lupine	Thistle
Bergamot	Blazing Star	Milkweed	
Black-eyed Susan	Goldenrod	Sunflower	

Gathering If at all possible, involve students in the gathering process. Introduce or review the guidelines for responsible gathering and make certain you have permission before gathering at a site. If it is not possible to gather native plants but you want students to investigate natural dyes, there are many easily obtainable herbs, fruits, vegetables and alien plants that make excellent dyes.

Dye Preparation Follow the directions in a resource book about proper dyeing techniques. Generally fresh plants produce the brightest dyes although dried plants can work. You will need about one pound of fresh plants for each pound of fabric you wish to dye.
Cloth Preparation Your cloth should generally be prepared in a mordant before dyeing. A mordant will bring out the color of the dye and will make it light-fast. Alum is a good, non-toxic, readily obtainable mordant. Pour a few tablespoons of alum into a very large pot of water. Heat to boiling and boil your fabric for about 15 minutes. Remove from water and let dry thoroughly before dyeing.

Dyeing Cloth can be dyed by dipping the cloth in the dye and letting it sit until the desired color is reached, painting the dye with a paintbrush, tie-dyeing or batiking.

Discussion Throughout the process facilitate discussions on dyeing traditions of Native Americans and pioneers, dyeing techniques today, the chemical processes occurring during dyeing, and so on.

A Prairie Diet

Source: Robin Greenler
Subject: **Social studies, science, math, language arts**
Grade: 6-12
Summary: Students research edible wild plants of the prairie and compare a prairie-based diet to their own.

Activity Time: variable
Materials: resource books on edible native plants (an excellent resource is Edible Wild Plants of the Prairie, by Kelly Kindscher, University Press of Kansas, Lawrence, Kansas)
Season: any

Activity: Have students research which prairie plants were used as food sources by earlier prairie-dwelling cultures. Develop a hypothetical full meal's menu based on available prairie foods. Include meat from prairie animals, if desired. Note: these foods will not be collected; the activity is intended to give students a feeling for eating only foods provided by the prairie.

Extension:
* Estimate the amount of time it would take to find, collect, and process (grind, dry, etc.) the food for your native prairie meal.
* Calculate the cost of a typical dinner for your household. How many hours, at $5.00/hour, would you have to work to purchase that meal? Compare to the hours estimated for collection and processing for the native prairie meal. Compare menus and time estimates for each member of the class.
* Survey which portions of the prairie plants were most often eaten (root, stem, leaf, flower or seed).
* Discuss the moral and ethical issues involved with collecting plants to eat. How can plants be gathered in responsible and respectful ways? Are these issues different for hunting animals for meat? Can animals be hunted in responsible and respectful ways?
* Keep track of all food you eat for an entire day. List all plants or plant parts you consumed in that day. Determine what portions of the plant you most frequently eat. Compare the lists of all students in the class. What is the most common plant part eaten? * How does a native prairie diet compare to ours? Think about factors such as nutrition, dependability, seasonality, variety and safety.

Prairie Strength/Prairie Weakness

Source: Robin Greenler
Subject: **Social studies, science,** language arts
Grade: 3-12
Summary: Students discuss the connection between prairies, prairie soil and the cultivation of the corn and grains in the U.S.

Activity Time: 45-60 minutes
Materials: maps of the U.S. prairie ranges in 1850 and at present and of the corn, wheat and grain production in the U.S. (Appendices 1 and 2)
Season: any

Activity: It has been said that the great strength of the prairie was ultimately its undoing. Have the class consider this and brainstorm about what "great strength" this might be referring to. After generating a list of assets that the prairie might have had, pass out two maps, one showing prairie acreage in the U.S. from 1850 (Appendix 1, "Prairie Boundaries in the United States") and another showing the production of corn and grain in the United States (Appendix 2, "Corn, Wheat and Grain Production in the United States"). The U.S. is generally considered to have some of the best corn and grain producing acreage in the world (sometimes referred to as the "Breadbasket of the World").

What is the connection between the two maps? Now have the students consider what "great strength" from the prairie may have created the exceptional agricultural conditions of North America. If students do not bring up soil created by the deep and extensive prairie roots, introduce this concept into the discussion. For background on what made the prairie soil is so fertile, see the Prairie Ecosystems portion of the background section.

Extension:
* In essay or discussion format have the students consider other instances where the strength, beauty or utility of an area ultimately causes it to be destroyed. Consider things like natural areas, rural urbanization patterns or rare wildlife habitats.
* In essay, discussion or debate format have them respond to the question "Should the prairies have been cultivated?"

What Happened Here?
Part I: Cultivation and the Prairies

Source: Robin Greenler
Subject: **Social studies,** language arts
Grade: 6-12
Summary: Students research agricultural trends in their area since 1800 and relate it to the loss of prairie land.

Activity Time: variable
Materials: resource materials
Season: any

Activity: Develop a time line that illustrates changes in prairie acreage and agricultural acreage in your area from 1800 to the present. Information about local agricultural acreage can be obtained from your local agricultural extension agent. On your time line, identify changes in prairie and agricultural acreage, and single events that affected agricultural practices such as invention of the first steel plow (which allowed much easier cultivation of the tough prairie sod), building of the railroad (which created a market for exporting agricultural commodities) or jumps in land value. The class as a whole can develop the time line with students researching individual components of it or the time lines can be small-group or individual projects. The three activities entitled "Land Use History" highlight some useful resources for researching land use trends.

Upon completion of the time line, discuss which factors played a significant role in the loss of the prairie in your area. Discuss other impacts on the prairies not related to agriculture. Note: The activity entitled "What Happened Here? Part II: Urban Development and the Prairie," examines the effects of urbanization in a parallel activity.

Extension:
* In an essay, discussion or debate consider the question, "What was lost and what was gained in the transition from prairie to cultivated land?"
* Have students design a plan where prairies and cultivation might co-exist. Given what we know now, design a land use and settlement plan that might have been useful for European settlers when they first entered your area.

What Happened Here?
Part II: Urban Development and the Prairie

Source: Robin Greenler
Subject: **Social studies, math (extension)**, language arts
Grade: 6-12, extension 3-12
Summary: Students research population and settlement trends since 1800 and relate them to loss of prairie in their area.

Activity Time: Research and time line development: variable. Discussion: 30 minutes.
Materials: resource materials
Season: any

Activity: Develop a time line that illustrates changes in settlement, land use and urbanization in your area from 1800 to the present. Identify changes in acreage consumed by prairie and by urban settlement on the time line as well as overall population figures. How has that population been distributed? Include single events such as building of the railroad, inception of significant commerce or industry job opportunities in the area and other events likely to have altered settlement trends in your area. The class as a whole can develop the time line with students researching individual components of it or the time lines can be small-group or individual projects. The three activities entitled "Land Use History" highlight some useful resources for researching land use trends.

Upon completion of the time line, discuss which factors played a significant role in the destruction of the prairie in your area. Discuss other factors that may have contributed to the loss of prairie land. Note: The activity entitled "What Happened Here? Part I: Cultivation and the Prairie" examines the effects of agriculture in a parallel activity.

Extension:
* **For grades 3-8:** What town and city names in your state reflect their prairie heritage? Are there any other natural landmarks that bear prairie-related names? Mark these cities and landmarks on a map and correlate with the historical prairie boundaries. Do some states have more cities named after their prairie heritage than yours?
* **Math:** Given a map of the historical prairie boundaries in your state, calculate the prairie acreage consumed by large cities.

III. Prairie Plants

Back to Back Revisited

Source: Sonja Nikolay
Subject: Science
Grade: K-2
Summary: Students learn plant parts through a movement game.

Activity Time: 1-5 minutes
Materials: none
Season: any (indoors)

Activity: Back to back is a socialization game used to teach body part names. The children choose partners and, following the teacher's directions, touch: back to back, nose to nose, toes to toes, knees to knees, and so on. To teach plant parts, students would imagine they are a plant and touch roots to roots, leaf to leaf, stem to stem and flower to flower. The parallels between body and plant parts is spatial only. Functional parallels such as leaves as food gathering parts and flowers as reproductive parts doesn't work well for this game.

Big Seed, Little Seed

Source: Robin Greenler
Subject: Science, math
Grade: 9-12, advanced 6th-8th grade students
Summary: Students examine seed production strategies by correlating average number of seed produced per plant with average weight of seed. Germination percentages are then examined.

Activity Time: In field: 30-60 minutes. In classroom: 1-2 hours.
Materials: fine scale (weighs grams), pots and soil (for extension)
Season: fall

Activity: As a rule of thumb, plants produce fewer larger seeds (each of which has a better chance of survival) or more smaller seeds. But how valid is the correlation between seed size and seed "set" (number of seeds produced)? Is survival, then, related to seed size?

Each student or small group chooses one species of plant in the field that is currently bearing seed. Count or estimate the number of seeds/plant on 5 individuals of that species. Find average seed production. Compile class data and rank plants based on seed production. Weigh 5-10 seeds, average weights and, using entire class data, rank plants by seed weight. Compare the two rankings. Are there any trends? Graph weight versus number. Discuss the best strategy or strategies with respect to seed weight and number. What other factors will affect total seeds surviving to maturity from a given parent plant?

Extension: Test germination of seeds from parent plants that have greatly different seed size and production strategies. Is there a correlation between germination percentage and seed size or seed production? Given the total number of seeds produced per plant and a plant's germination percentage, calculate the average number of seeds germinating per plant. See the "Extension for Older Students" in the activity entitled "Roots and Shoots" for a good germination testing procedure.

Construct A Key

Source: Robin Greenler
Subject: Science, art (extension), language arts
Grade: 6-12
Summary: Students devise a classification key for prairie plants.

Activity Time: 1 1/2 to 2 hours
Materials: dried flowers and grasses, if done indoors
Season: Outdoors: Early spring, summer, late fall Indoors: any

Activity: Keys are useful ways to identify plants. By asking a series of questions that have only two possible answers each, one is able to track down an individual plant quickly and efficiently.

Have the students devise a simple key based on 5-8 plants that are either in the field or dried in the classroom. A good key will give a first choice that divides the group of plants into two, roughly equal categories based on some fairly obvious trait. Then each sub-group will be given another choice, which will further divide that group into two fairly even groups. Appendix 3, "Sample Key," gives an example of a simple key that may be useful for demonstration purposes.

Extension:

* Challenge the students to devise the following types of keys:
  A key that is not based on sight.
  A key that could be used by a five-year-old child.
  A key that uses only pictures and no words.

Design a Seed

Source: Georgia Gomez-Ibanez
Subject: Science, art, language arts
Grade: 3-8
Summary: Students design a seed with good survival adaptations.

Activity Time: For younger students, each step of designing, modeling, writing and judging should take about 30-60 minutes for a total of two to four hours. For older students, the project could be much longer.
Materials: modeling materials could include clay, pipe cleaners, fabric, straws, toothpicks, crepe paper, papier maiche, plaster of Paris, paints, glazes, etc.
Season: any (indoors)

Activity:
This activity is best followed by an examination or discussion of seed dispersal methods.

Design Have students design a seed. Younger students can imagine that they are prairie plants that cannot move themselves anywhere but still need to move their seeds out to places with good soil and away from competition with the parent. Have them pick a dispersal means such as wind, water, bird or mammal. Older students should design a "best" seed based on factors such as nourishment stores (the parent plant can produce more small seeds but each one has less nutrient reserves than a few large seeds), attractiveness to harmful predators, attractiveness to beneficial predators (such as seed dispersers), susceptibility to rot, cold temperatures, freezing/thawing and drought, cost to parent plant and dispersal method. Have students draw designs of their seeds.

Model Have the students make 3-D models of their seeds.

Report Have the students write or talk about their seeds, describing how they will work (younger students) and for what conditions they are well and poorly adapted (older students).

Judge For younger students, invite high school physics or biology students over to "judge" which seed designs might be most useful. For older students, have a symposium in which each student presents their seed design and it is discussed as a group.

Flower Child

Source: Helen Klibaner
Subject: **Science**, math, social studies
Grade: 6-12
Summary: Students discover variations and diversity within a plant species or family.

Activity Time: variable
Materials: none
Season: summer, early fall

Activity: Choose either one species or one family of blooming plants in the prairie. In small groups have students select one plant and find out everything they can about it without picking it. Information could include height, number of flower heads per stem, number of flowers per head, number or percentage of flowers blooming, past blooming and not yet blooming, number of leaves, approximate total surface area of leaves, etc. Alternatively, the teacher or class as a whole could determine which data to collect from every individual. Regroup and discuss variations. How do variations arise? How are variations useful in keeping the species strong? Connect to issues of diversity and stability. On an ecosystem level, how is diversity important? On a global level? Can there be too much diversity?

Getting to Know You

Author: Kathleen Morgen
Curriculum: Science, language arts
Grade: 3-12
Summary: Students investigate prairie plants and share their findings with the class.

Activity Time: 1 1/2 to 3 hours
Materials: cards with prairie species that are in bloom or otherwise recognizable
Season: late summer or early fall

Activity: Divide class into small groups. Each group selects, or is given, a prairie plant species and then develops three or more questions about their species. The teacher should guide the students in developing questions for which answers will most easily be found in the field such as height, how the leaves feel, etc. They then investigate their species in the prairie to find answers to their questions. Students should be encouraged to find out more in books. Each group should then teach the other students about their species. Encourage students to devise creative ways to teach about their species such as a poem, song, riddle, skit, etc.

Grasses are Wild

Source: Kathleen Morgen
Subject: **Science, art,** language arts
Grade: K-2
Summary: Students do rubbings of various grasses to learn more about them.

Activity Time: 30 minutes
Materials: prairie grasses, paper, crayons
Season: any (outdoors in fall, indoors for other seasons)

Activity: Collect grasses at the seed-bearing stage. Common native species include Indian grass, switch grass, Canada wild rye, big bluestem, little bluestem, sideoats grama grass, needlegrass, prairie cordgrass, and prairie dropseed.

Have students do crayon rubbings and learn the name of the grass. Students can write the name of the plant or a sentence about the plant on the picture.

Extension: What does the name tell you about the plant? Create a legend about how the plant got its name.

Model a Seed

Source: Greg Bisbee
Subject: **Science**, art
Grade: 9-12
Summary: Students make a model of a prairie seed, including important features of the seed.

Activity Time: 1-6 hours, depending on sophistication of the model
Materials: modeling materials, as desired
Season: any (indoors after seed is collected)

Activity: Collect seed from a prairie restoration or remnant. Each student selects a species to study and creates a model of the seed of that species to present to the class. Include internal seed anatomy, if possible.

This fits in well with students adopting one species of plant for the school year that they grow, model and research (see the chapter "Integrative Activities and General Strategies," section "Adopt-a-Plant").

Photographic Life Cycle

Source: Greg Bisbee
Subject: Art, science, photography
Grade: 9-12
Summary: Students photograph the seed-to-seed life cycle of a prairie plant.

Activity Time: If an entire life cycle is to be captured, this project would take occasional photographic sessions over an entire school year. To get pictures of the seedling only would take 1-12 weeks, depending on the species.
Materials: seed, potting soil, pots (can use 2-liter soda bottles), grow lights (a south-facing window ledge may be sufficient) and camera
Season: Start indoors in fall. Seed must be stratified and ready to germinate.

Activity: Have each student photograph a seed-to-seed life cycle of a prairie plant. Include stages such as germination, first true leaf, blooming, seed set and seed ripening. This fits in well with students adopting one plant for the school year that they grow and research (see the Chapter "Integrative Activities and General Strategies," section "Adopt-a-Plant"). This can be done either indoors in pots or in a prairie remnant or restoration.

Alternatively, students can grow and photograph seedling stages of prairie plants. If these photographs are compiled and identified, they can provide a resource that enables students to distinguish prairie and weed seedlings in their restoration planting.

Prairie Flower Game

Source: Sonja Nikolay
Subject: **Science, language arts**
Grade: K-2 (extension: 3-8)
Summary: Students learn to identify prairie plants from pictures around the room.

Activity Time: 5 minutes minimum
Materials: large pictures of grasses and forbs
Season: any (indoors)

Activity: Place pictures of forbs and/or grasses on walls around the room. Children go to the center of the room. Teacher calls out name of plant and children move to touch correct picture. Instead of the name, the teacher could call out a description of the plant or its history.

Extension:
* **Language arts (K-2):** Teacher calls out the sound or letter that starts the plant's name.
* **Language arts, science (3-8):** Ask students an open-ended question and have them defend their choice. Questions could challenge them to pick their favorite flower, the most important plant on the prairie, the plant that is a favorite of insects, etc.

Prairie Geometry

Source: Georgia Gomez-Ibanez
Source: Math, science, art
Grade: K-5
Summary: Students find prairie plants that represent geometric shapes.

Activity Time: 30 minutes to find plants, 30 minutes to add pictures to shape book
Materials: set of cards with labeled pictures of the common geometric shapes (circle, square, triangle, rectangle, oval, pentagon, hexagon, octagon), a classroom shape book containing shapes found everywhere (optional)
Season: Late spring, summer, early fall

Activity: Give each child a card and ask them to look around the prairie until they find a plant or plant part shaped like their shape. Tie a red string around the plant and at the end the class can gather to admire everyone's discovery. Children might draw their prairie shape on another card. These drawings could be added to a classroom shape book.

Prairie in the Dell

Source: Sonja Nikolay
Subject: Science, music
Grade: K-2
Summary: A prairie variation of "Farmer in the Dell" helps with plant recognition and general prairie familiarization while refreshing the children's bodies and providing a good socialization activity

Activity Time: 15 minutes
Materials: prairie plant pictures strung with yarn to make a necklace; one for each student
Season: any (indoors)

Activity: Wearing their necklaces, students form a large circle, hold hands and sing the following, to the tune of "The Farmer in the Dell":

The prairie in the dell,
The prairie in the dell,
Hi oh, the prairie oh,
The prairie in the dell.

Susie *(whoever is "it")* plants a seed,
Susie plants a seed,
Up comes Baptisia *(Susie chooses Baptisia by pointing to Tyrone, who is wearing the Baptisia picture. Tyrone will be the next "it")*
Susie plants a seed

Tyrone plants a seed, etc.

When all the children have been chosen and are in the circle, they should sing the last verse as they dramatize their plant.

Watch our prairie bloom,
Watch our prairie bloom,
Hi oh, the prairie oh,
Watch our prairie bloom.

Prairie Plant Growth

Source: Robin Greenler
Subject: **Science**, math
Grade: K-12
Summary: Students plant a prairie seed to observe the plant's life cycle or experiment with the effects of various environmental conditions on growth.

Activity Time: depends on design
Materials: 2-liter soda bottles, soil, seed, grow light
Season: any

Activity: Growing a prairie plant in a soda bottle is an easy and inexpensive way to observe a prairie plant's life cycle, examine root growth, experiment with the effects of environmental conditions on growth and learn more about individual species. Appendix 4, "Bottle Column Construction," shows how to make self-watering bottle constructions; additional root units can be added on as necessary. Individual students or the class as a whole can grow the plants and observe them generally. Alternatively, they can set up a specific experiment and explore the results. Experimental questions can examine effects of temperature, light, fertilizer type, amount or schedule, watering schedule, soil or competition. Growth rates examined can include height, time to germination, time to first leaf, total number of leaves, time to seed set, size of seed set, root length, total root mass, etc. Students can make comparisons between species as well.

Healthy plants without too much root can serve as transplants in the prairie and the students can develop a protocol for growing transplants in the future.

Extension: See the activity entitled, "Root Growth" for a procedure for observing and measuring root growth with a similar bottle set-up.

Prairie Plant Height

Author: Christina Mandt
Curriculum: **Math**, science
Grade: 3-5
Summary: Students measure and analyze heights of various prairie plants.

Activity Time: 45 minutes
Materials: measuring sticks
Season: summer, early fall

Activity: Students measure various plants' heights from a restoration or remnant. Students then graph the data. Interpretive questions for the exercise can include: Which is the tallest (shortest) grass (forb)? Which is taller (shorter), X or Y? Which forbs are taller than one foot? What is the average height for all forbs (grasses)?

Extension: If plant height and temperature and rainfall data are recorded each year, students might begin to see correlations between environmental conditions and plant heights.

Roots and Shoots

Source: Kathleen Morgen
Subject: Science, Math
Grade: 3-8
Summary: Students grow plant sprouts in a jar and measure the shoot and root growth. They then consider prairie root growth.

Activity Time: one week (approximately 15 minutes/day for first four days; 30 minutes on day five)
Materials: mung bean, radish or alfalfa seeds, jar
Season: any (indoors)

Activity: Soak seeds in jar of water overnight. Drain the next morning. Rinse and drain every day for 3-4 days. Have students sketch and measure root and shoot growth each day. When your have finished your final measurement, eat your harvest!

Extension:
* Show students a drawing of a mature prairie plant and its roots (Appendix 5, "Prairie Plants: Roots and Shoots.") Have students measure the roots in the picture and calculate their size in real life. Discuss why the roots grow so deep.
* **For older students:** Construct a seed germination plate as shown in Appendix 6, "Seed Germination Plate." Place seed along center grid line and record root and shoot growth daily. Graph the growth. Students could explore the effects of environmental conditions on plant growth (temperature, light, water source, etc.). Students could compare growth of prairie seeds such as yellow coneflower, black-eyed Susan, bergamot or any grass.

See What Transpires

Author: Lynn Preston
Curriculum: Science, math
Grade: 6-12
Summary: Students design and conduct investigations to learn about and compare plant transpiration rates.

Activity Time: 1-2 hours
Materials: cobalt chloride paper, clear tape, paper clips, plastic bags and twist-ties
Season: late spring, summer, early fall

Activity: It is thought that, due to intense summer suns, high transpiration rates (high water loss) pose a significant challenge for prairie plants. Students can compare transpiration rates of leaves and set up their own experiments based on queries about the relationship of transpiration rate to plant species, plant habitat (dry or wet), water stress adaptations (hairiness, waxy leaves, size, etc.), time of day, season or various weather conditions. For younger students, a class question can be defined and each small group of students can run one test. The data can then be collated and, as a class, the students can examine it and draw conclusion.

To set up the transpiration monitors, apply clear tape to both sides of half of a strip of cobalt chloride paper, paper clip the strip to the leaf and enclose the entire leaf with a plastic bag (closed with a twist-tie). The taped area will remain blue and the exposed area will turn pink as it is exposed to moisture. The students then wait for a set period of time and then cover the exposed portion of the paper (both sides) with clear tape after a set period of time. Students can compare the plants based on their "degree of pinkness." Alternatively, students can time how long it takes for the test strip to turn from blue to pink. In this case, you will need a "standard pink color" available for each student so they know when their paper has turned sufficiently.

Seed Stratification

Source: Greg Bisbee
Subject: **Science,** math
Grade: 9-12
Summary: Students design and carry through an experiment on the effects of various treatments and treatment lengths on prairie seed germination.

Activity Time: variable, the experiments must run over a minimum of three months
Materials: seed, equipment for various seed treatments depends on experimental design
Season: late fall, early winter for seed collected previous growing season

Activity: While some seeds will grow immediately after ripening on the parent plant, it is much more common for prairie plants to undergo a period of dormancy. The seeds then need some environmental trigger to break dormancy and allow germination. These triggers include a specific temperature regime (often a period of cold followed by a period of warmth), light (generally the proportion of daytime to nighttime), or scarification, the breaking of the seed coat. For a thorough discussion of dormancy and seed treatment, see Prairie Restoration for Wisconsin Schools.

After presenting background material on seed physiology and dormancy, students select one species and design an experiment to determine the stratification regime that will result in the highest germination percentage. Students may start by researching current stratification recommendations (see Prairie Restoration for Wisconsin Schools, "Species Data Base" section). Students should understand that these recommendations represent the current wisdom but are being frequently updated and refined. Prairie seed stratification methods are not fully understood. Students then design an experiment to test variations in the stratification process. Variables to examine could include length of treatment, temperature, storage conditions, moisture content, method of scarification or degree of scarification. The experiment should include germination tests to assess success of stratification method (see the extension for older students in the activity "Roots and Shoots" for a good germination testing procedure). Students should be encouraged to continue to grow their seeds and observe life cycles (see the activity "Photographic Life Cycles"), or grow the plant for transplants (see the activity "Prairie Plant Growth").

This fits in well with students adopting one species of plant for the school year that they grow, model and research (see the chapter "Integrative Activities and General Strategies," section "Adopt-a-Plant").

Solar Graphics

Source: Sonja Nikolay
Subject: **Art, science, language arts**
Grade: K-8
Summary: Students create an identification sheet for a prairie plant using solar graphic images.

Activity Time: 30 minutes minimum
Materials: solar graphics paper
Season: spring, summer, fall

Activity: Have students choose a single plant and make a solar graphic that can be used to identify that plant. (Consult the package instructions for details.) Students may wish to make a series of graphics that illustrate the key features of the plant such as leaf arrangement (alternate, opposite or whorled), leaf margin (smooth, toothed, lobed), key flower characteristics, etc. Include a written description of the plant as well as features that cannot easily be illustrated.

All sheets can then be collected to make a complete class prairie identification manual. The manual can be duplicated for each student.

Extension:

* Small groups or individual students could make an informational sheet describing the difference between leaf margin types, leaf arrangements on plants, flower types or other common plant identification features.
* Small groups could each be assigned one of the five major prairie plant families--Composite, Grass, Legume, Mint, Rose. Each group could collect a series of solar graphics illustrating some individuals in that family.
* Other uses for solar graphics include framing for display, making cards for invitation to a prairie function, illustrations for a prairie newsletter, or to accompany general PR material such as an article sent to a local paper.

Survival Scavenger Hunt

Author: Kathleen Morgen
Curriculum: **Science**, math, art
Grade: 3-12
Summary: Students search for certain types of plant adaptations.

Activity Time: 30 minutes minimum
Materials: small bags (one for each 2-3 students) each including a piece of waxed paper, piece of fur, thin green ribbon, doily or "snowflake" cut paper piece and sandpaper
Season: late spring, summer, early fall

Activity: Introduce students to the concepts of plant adaptations focusing on the prairie environment and the related plant adaptations. In groups of 2-4 students have students see how many different plants they can find that have adaptations represented by the objects in the bag (waxiness, hairiness, finely divided leaves, rough leaves, narrow and/or curled leaves). Have students sketch the plants or trace one leaf without harming the plant. Regroup and compare findings.

Where Do I Fit?

Source: Robin Greenler
Subject: Science, art
Grade: 3-12
Summary: Students develop their own classification scheme for prairie plants.

Activity Time: In prairie: 30-45 minutes minimum. Classroom discussion: 30 minutes minimum.
Materials: none
Season: late spring, summer, early fall

Activity: Plants are identified by certain characteristics. Some characteristics are not good identifying features while others are very good and are commonly used. In this exercise, students will look more closely at plants and their identifying traits. Commonly used traits include leaf shape and arrangement on stem, flower color, shape and placement on the plant and plant form.

While in the prairie, have students classify all the plants they see into categories that are logical for them. Younger students may be told to classify in a certain way (by flower color, plant height, leaf shape, etc.) but would be left to devise their own categories (blue, white, red and mixed flower color; knee height, waist height and taller, etc.). Older students may be left to come up with their own categorization scheme. They can use a single scheme and lump many plants into a few categories or can use multiple schemes together and more finely divide the categories. Some possible categorization schemes include flower color, flower shape, flower size, placement of flower on plant, number of flowers on plant, flower fragrance, blossoming strategy (all at once or one at a time), plant form (tall, bushy or creeping), plant height, amount of branching on plant, leaf size, leaf shape, leaf placement on stem or blooming time of plant.

In order to identify the plants, the students can use a key, if available, or can sketch and/or describe the plant. Upon return to the classroom, discuss the different schemes students used and the problems they encountered with those schemes.

This activity could be followed by the activity "Construct A Key," which has the students construct a simple key based on their categorization schemes.

Which Way is North?

Subject: Kathleen Morgen
Subject: Science, math
Grade: 3-8
Summary: Students observe, develop and test a hypothesis about the orientation of the leaves of compass plant (Silphium laciniatum).

Activity Time: 1-2 hours
Materials: compasses
Season: late spring, summer, early fall

Activity: Show students leaves of compass plants (Silphium laciniatum) in the field and examine the orientation of the leaves relative to the sun. What orientation could help large-leaved plants minimize water loss? Develop a class hypothesis and devise an experiment to test the hypothesis using teams of 3-4 students. Compare orientation to other large-leaved plants such as prairie dock (Silphium terebinthinaceum).

IV. Prairie Insects, Birds and Mammals

An Ant's-Eye View

Source: Dan Flesch
Subject: Language arts, science
Grade: K-2
Summary: Students visualize that they are a small ant in the prairie and describe their experience.

Activity Time: 20 minutes minimum
Materials: none
Season: any (indoors)

Activity: Ants are a very abundant invertebrate of the prairie. Many live in mounds and can travel long distances in a day. Pretend that you are a tiny ant on a plant in the prairie as the wind is blowing all around you. You are crawling all over the plant. (The instructor might want to describe a specific plant.) Think of many, varied, single words to describe what you might be experiencing. As students suggest words, write them on the board.

Extension: Have the students use the words generated as they write a story.

Butterfly Inventory

Source: Kathleen Morgen
Subject: Science, math
Grade: K-12
Summary: Students observe butterfly pollination and nectar collecting behavior.

Activity Time: In field: 45 minutes minimum. Classroom discussion: 20 minutes minimum.
Materials: field identification guides, if desired
Season: summer or early fall

Activity: For younger students have them follow a butterfly to see how many different kinds of plants it uses. What does it do as it visits each plant? Does it visit only plants in flower? Inventory the butterflies on a remnant or restoration. How many different kinds of butterflies can you find? With the help of a field guide, try to identify them. Which plant(s) does the butterfly prefer? Compile class data and discuss.

Extension for Grades 6-12: Construct a good sampling method for determining the number of butterflies in a remnant or restoration. Compare with the school yard or a manicured park.

The Flight of the Bumble Bee

Source: Robin Greenler
Subject: Music
Grade: K-12
Summary: Students analyze an insect's song and behavior and develop a musical composition to evoke it.

Activity Time: 20 minutes
Materials: Rimsky-Korsakov's The Flight of the Bumble Bee, other non-traditional versions optional. An interesting version is Yo Yo Ma and Bobby McFerrin's version on their compact disc entitled Hush (Sony Music Entertainment, 1992), which performs the piece as a cello/voice duet.
Season: early fall for field observations, any time for rest

Activity: Observe insects in the prairie. Pick one insect and imagine you are a composer trying to evoke that insect through music. What instrument(s) might you use? Would the players play low or high? fast or slow? loud or soft? smooth or choppy? melodious or dissonant? with periods of silence or music without pause? a single instrument or many? a long or short piece? Have students present a description of their insect and the musical piece they envisioned. Older students could develop a composition. Note: You do not have to imitate only the sound of the insect. Your musical choices can evoke the behavior, appearance, or activities of the insect.

Extension:
* Listen to Rimsky-Korsakov's Flight of the Bumble Bee. Discuss the musical choices he made. Have the students consider how they might do it differently.
* Listen to different interpretations of the Flight of the Bumble Bee to see how others have interpreted the music.
* Read the poem for two voices entitled Joyful Noise, by Paul Fleischman, Harper Row, 1988. Discuss how the voices become instruments in the poem.
* Students could make an instrument (out of recyclable/throwaway materials) that could mimic the insect of their choice.

How to Be a Bee

Source: Robin Greenler
Subject: Science, math
Grade: 9-12
Summary: Students observe the behavior of an insect foraging for nectar and determine its foraging strategy.

Activity Time: In the field: 2-3 hours. Data analysis and discussion: one hour minimum.
Materials: measuring tape, timer
Season: late spring, summer, early fall

Activity: Insects must expend a large amount of energy foraging for nectar. Unless they are able to forage efficiently they will spend more energy looking for nectar than they receive from the nectar itself. So, in order to survive, insects have developed sophisticated ways of foraging efficiently. This foraging behavior is called Optimal Foraging Strategy and has been the focus of much scientific research.

In order to forage efficiently, an insect needs to visit only those flowers that have a large quantity of nectar (that haven't been recently visited, that are an appropriate age for maximum nectar production or that come from a plant that is producing high quantities of nectar). We do not understand how insects "decide" which flowers to visit but know by observation and experimentation that they "make" very efficient decisions.

In this activity, students will observe the behavior of a foraging insect and begin to determine its foraging strategy. If an insect visits a flower that has a lot of nectar (a "hot" flower), it might be assumed that its next visit will be to a nearby flower, whereas a visit to a "cold" flower (one without much nectar) might result in the insect going a long distance for the next flower visit. Test this hypothesis by observing a pollinator, recording the length of time spent at each flower in nectar collecting, and the distance flown for the next collection. Data collection may require a team of individuals in order to record times, distances and not lose sight of the insect!

Life in a Gall

Source: Robin Greenler
Subject: Science, math
Grade: 6-12
Summary: Students observe insect galls and develop studies based on distribution, frequency, plant-host relationships and seasonal variation.

Activity Time: variable; collection and dissection: one hour.
Materials: prairie or old field
Season: summer, fall, winter

Activity: Some insects insert an egg into the stems and leaves of plants. The surrounding plant tissue reacts to form a large mass or gall. The egg develops within the gall; then it hatches and the larval stage feeds upon the surrounding plant tissue. Galls are easy to observe on some prairie plants such as goldenrods.

In goldenrods, a gall fly lays her egg at the tip of a goldenrod stem in young folded leaves. After hatching the larva bores into the stem's growing tip and secretes chemicals that cause the plant to grow a gall around it. In the fall, the larva chews a tunnel almost to the surface of the gall and spends the winter there. In the spring the larva changes into a pupa and then into an adult fly and then emerges through the gall.

Have students find galls in the field. Dissect the contents and observe which life cycle stage the insect is in. Below is a list of potential individual or class studies.

Which plants have galls? Observe and record frequency of gall presence for different species of plants.

Who is in the galls? Observe and record frequency of which insect is in a gall. This can be done without absolute identification of the insect as long as similar and different ones can be identified. Students can test to see if there is a correlation between host plant and insect species.

Where are the galls? Where on the host plant are galls most frequently located? A student could simply look at which plant parts contain galls such as the stem, petiole, leaf, etc. A more careful analysis might examine stem gall, for instance, and determine if galls locate based on height, stem diameter, leaf proximity or some other factor.

Seasonal changes During which months are galls most numerous? Do different insect species produce galls at different times? Do plant hosts have galls at different times? Chart the phenology of insect galls.

Gall distribution Study the pattern of gall distribution on

plants. Are galls distributed in a clumped pattern or at random?

The Marvelous Monarch

Source: Kathleen Morgen
Subject: Science, language arts, math, social studies, art
Grade: K-8
Summary: Students observe monarch larvae as they undergo metamorphosis from larva to chrysalis (pupa) to butterfly.

Activity Time: two to three weeks
Materials: monarch butterfly larvae, large jar or box, milkweed stalks or potted milkweed plants
Season: fall

Activity: Late August or early September is prime time for finding monarch butterfly larvae on milkweed plants. The familiar yellow-green caterpillar with black stripes requires a continuous supply of fresh milkweed throughout its larval stage. Place in a screened box or jar with a daily supply of fresh milkweed leaves. Do not place more than 5 larvae in the container at one time. Four times during their larval stage, caterpillars shed and eat their skin. On the fifth and final molt, the pupal form (chrysalis) is revealed. Approximately two weeks later, the transformation is completed as the butterfly emerges. Before the killing frosts of fall, monarchs head out in mass migrations for the mountains of Mexico.

All throughout the rearing process, teachers can use monarch development across the curriculum at levels from K-12. Some examples follow.

Science: Observe adult monarchs in the prairie. Observe and record the time spent feeding and distance flown. In the classroom, calculate mass eaten (compare to body weight), weight change throughout the life cycle, time spent in each stage, etc.

Language Arts: Write poetry, legends, creative stories.

Math and Social Studies: Research migration route, examine migration terrain and weather conditions and compute migration miles.

Art: Make models of monarch life cycle stages. For younger students, place colored paper stems throughout the room. Have each group of four students cut out caterpillars, a chrysalis and a butterfly. Hang larvae and chrysalis on the stems and huge butterflies from the ceiling.

A Plant and Its Insects

Source: Kathleen Morgen
Subject: Science
Grade: 6-12
Summary: Students observe insects that live on specific plant species.

Activity Time: 3-4 hours minimum
Materials: insect identification guides, if desired
Season: summer or early fall

Activity: Each student adopts and observes a single plant or plant species and, if possible, identifies the insects that are on it or visit it. The entire class may choose one species with individual students or small groups observing different plants. Class data can then be compiled and examined. Older students may identify a hypothesis and design an experiment to test it. Questions could involve insect behavior at different times of day, in different seasons, or on days with different weather conditions (wet/dry, sunny/overcast, hot/cool).

Extension:
* Students may be able to participate in the "Prairie Plant/ Invertebrate Relationship Study" from Riveredge Nature Center, Newburg, Wisconsin (see Appendix 7, "Prairie Invertebrate Study").
* Discuss the relationship between the plant and insect. Does either benefit? Is either harmed?

Pollination Observations

Source: Robin Greenler
Subject: Science, language arts, math
Grade: 3-8; 9-12 for extension
Summary: Students observe insect pollination and consider what is happening to both plant and insect.

Activity Time: Field observations: 20 minutes. Discussion: 20-40 minutes. Time for extension depends on design.
Materials: none
Season: late spring, summer, early fall

Activity: Have the students observe insect pollination in the prairie with the following questions in mind: What is the insect doing? Why? What does the plant get out of the interaction? Discuss their observations and thoughts about the questions. Discuss the costs to the insect and to the plant in this interaction. Consider factors such as energy spent (foraging for the insect and growing flowers or producing scent for plants), susceptibility to predators and vulnerability to foul weather.

Language Arts Extension: Write a dialogue or script between an plant and pollinator about plant pollination.

Extensions for Older Students:
* Have students work in groups and pick an individual plant (each group can focus on a different species or the entire class can focus on one species, comparing different individuals of that species). Count how many pollination visitors each plant receives. You may want to distinguish between a successful visit (nectar and/or pollen was probably obtained) and a visit in which the insect did not actually appear to collect nectar or pollen.
* Keep track of what type of pollinators visit your plant.
* Record total time insect visitors spend foraging for nectar or pollen.
* Determine if insects visit more frequently at certain times of the day.
* Determine if the frequency of insect visits varies based on weather.
* Develop a seasonal phenology of insect visitors throughout the fall.

The Useful Prairie

Source: Dan Flesch
Subject: Science, language arts
Grade: K-5
Summary: Students brainstorm different ways animals may use the prairie.

Activity Time: 30 minutes minimum
Materials: none
Season: any (indoors)

Activity: Generate a list of all animals that might live on a prairie. Include soil decomposers, insects, birds and mammals (don't forget humans). Then have students brainstorm all the different ways animals might use the prairie in terms of food, shelter and protection. As students share, write a list of the ideas on the board.

Extension: Consider how this list may vary in different seasons.

What is a Life Cycle?

Source: Georgia Gomez-Ibanez
Subject: Science, language arts, math
Grade: K-2
Summary: Students examine and sequence life cycle stages of various organisms.

Activity Time: 15 minutes minimum
Materials: Flannel boards with life cycle figures
Season: any (indoors)

Activity: Talk about the stages of life that a person goes through including fetus inside mother, newborn, toddler, child, teenager, etc. Have students sequence the stages of a prairie plant including seed, sprout, flower and mature plant with seed. Make sure the sequence is cyclical, not linear. Students could play-sequence the life cycle of the chosen organism.

Extension:
* Sequence the life cycle stages of a butterfly including egg, larva, chrysalis and adult butterfly.
* Sequence a bird life cycle including egg, fledgling and adult.
* Discuss the most vulnerable stages of a life cycle and what strategies have evolved to protect the organism at those times.

Who is Calling?

Source: Robin Greenler
Subject: Music, science
Grade: 3-8
Summary: Students listen to bird calls and find similarities with musical instruments.

Activity Time: In the field: 30 minutes minimum. Classroom discussion: variable.
Materials: Reference for identifying bird songs such as The Peterson Field Guide Series recording, "A Field Guide to Bird Songs." Many others are available.
Season: late spring, summer, early fall; best time of day is early morning

Activity: Listen to the bird calls in the prairie. As a group, how many different ones can you hear? Try to describe them in words, musical notation or by imitation. If possible, bring along a bird watcher who can identify the calls. If not, try to identify using one of the references listed above.

Have students pick one call and identify it, describe it and find a musical instrument that best imitates it. If the instruments that best imitate all the calls the students heard were assembled in a room, how would your "prairie orchestra" sound? Is there any popular ensemble that has a similar composition to your "prairie orchestra?"

Extension: Listen to pieces that mimic bird calls. These may include Dvorak's American Quartet (Opus 96), *scherzo* (incorporates the call of the scarlet tanager); Domezetti's opera Lucia, Act III, *The Mad Scene;* or Aaron Copland's Appalachian Spring. Which instruments were used to evoke the bird calls in those pieces?

Blooming Time

Source: Robin Greenler
Subject: **Science, math**
Grade: 5-12
Summary: Students follow a few plants through their blooming period to track when they reach their peak bloom.

Activity Time: In the field: 30 minutes per week through mid-October
Materials: none
Season: fall

Activity: See the activity entitled "The March of the Prairie," for an overview on phenological studies.

Students identify a single plant species in their prairie. Identify 5 individuals of that species to follow. Each week, students record the height and number of buds, flowers and seed heads on each plant. Calculate the averages. Graph the percentage of flowers that were in flower each week. Graphs or data from each student could be compiled on one class phenological chart. Charts from previous years' classes could be compared with the current year's chart.

Bulking Up

Source: Robin Greenler
Subject: **Science, math**
Grade: 6-12
Summary: Students estimate total biomass in a prairie and compare it to other ecosystems.

Activity Time: In the field: 30-45 minutes per plot. Classroom discussion: 20 minutes minimum.
Materials: measuring sticks or tape
Season: fall

Activity: Have students measure a 1-square-meter plot in the prairie. In groups or singly, have students estimate the above-ground biomass in that plot (volume of plant and animal matter). This is a difficult estimation to make. They should estimate large items, such as trees, separately and add them together. They may want to visualize piling up the rest of the material and estimate how big a pile it would make, and then calculate that pile's volume. Get a list of the different estimations and get a class mean. Repeat the exercise for another ecosystem such as an old field or lawn.

Calculate the root biomass in the prairie given the assertion that 90% of a prairie plant's biomass is underground in the roots.

What are the implications of total biomass? Consider factors such as herbivore and carnivore food sources, the soil, fire, shelter, fertility and competition.

Extension:
* Examine the role that the root biomass plays in enhancing prairie fertility in the activity entitled "From Soil to Soil."
* Discuss the differences in annual production of biomass for an ecosystem that produces new plants from seed each year (annuals), one that keeps the root systems underground and produces only above-ground material (perennials) and an ecosystem like a forest where many of the plants do not die back.
* Compare prairie biomass with the biomass in a field of timothy or alfalfa hay.

A Circle of Seasons

Source: Georgia Gomez-Ibanez
Subject: **Science, art, language arts,** math
Grade: K-2
Summary: Students choose a special location on the prairie from which they will record monthly observations. The observations are put on an annual calendar.

Activity Time: To make basic calendar: 30-45 minutes. Monthly observations: 30-45 minutes per month.
Materials: strips of heavy construction paper or light tag board 6 x 72 inches; one per student
Season: all (this is an all-year project)

Activity: Students measure out 12 6"-wide spaces for the 12 months and label them. Have them indicate the seasons on their calendar (you can use either the "official" seasons or the "Wisconsin" seasons).

In the prairie, each student picks a spot which will be his or her observation spot for the year. They then draw their observations on the square for that month or on a separate sheet that is glued on to the calendar for that month. Students make observations and drawings monthly. In June, students fasten the calendar ends together so the year becomes a circle, a cycle. July can be left blank; students can be encouraged to visit the prairie in the summer or they can project their guess for July during the June observation time.

A Different Sense

Source: Robin Greenler
Subject: **Language arts, science**, social studies
Grade: 3-8
Summary: Students experience the prairie with only one sense and compare perceptions.

Activity Time: 50 minutes minimum
Materials: none
Season: summer, early fall

Activity: Assign each student one of the four senses of sight, hearing, smell and touch. Have all students go out in the prairie and spend 10 minutes "observing" it using only the sense assigned them. Block off the other senses to the extent possible.

When they return from the prairie have them describe the prairie (orally or in an essay) using only information from their sense. Compare the descriptions and discuss.

Extension: Early settlers traveling through tall-grass prairies often could not see over the grasses and so were without many visual cues. Consider and discuss the following account from P.F. de Charleroix, an explorer in the early 1700s, as he looked over a southern Wisconsin prairie:

> *Nothing to be seen in this course but immense prairies, interspersed with small copses of woods, which seem to have been planted by hand; the grass is so very high that a man is lost amongst it, but paths are everywhere to be found as well trodden as they could have been in the most peopled countries, though nothing passes that way except buffaloes, and from time to time some herds of a deer and a few roe-buck.*

Given this description, how might you feel about the prairie that de Charleroix viewed? How would your perceptions differ if you were looking for a route west, a homesite for a family, an area to establish a town or just exploring?

The Eye of the Ancient Hunter

Source: Kathleen Morgen
Subject: **Social studies, science,** language arts, art
Grade: 6-12
Summary: Students consider the type of landscape that most attracts them and relate that to anthropological theories about human evolution and land settlement patterns.

Activity Time: 3 class periods of 40-45 minutes each
Materials: excerpts from Biophilia by E.O. Wilson, photographs of various local landscapes
Season: any (indoors)

Activity: There is a theory that humans, when given the option, gravitate to and select a habitat that harkens to the landscape where our species first lived. It is argued that this predisposition stems from ancient mentally ingrained survival strategies of the hunter/gatherer (Wilson, 1990). This theory may shed light on why our savannas (especially those overlooking water) were, and still are, prime homesites.

Ask students to imagine a landscape in which they most wish they could live. Have them sketch the landscape. Depending on your students' experience with a variety of landscapes, you may need to provide them with photographs of several local examples including those that are deeply wooded, treeless, flat, and hilly with and without water. Include a savanna-type site overlooking water. Exotic landscapes will generally hold appeal simply because they are different and should be avoided in this activity.

Have students read and respond to excerpts from "The Right Place," a chapter in E.O. Wilson's book Biophilia. Have them analyze their choices and sketches. Do they support his theory? What are the implications for continued settling of rural land (urban sprawl)?

Extension: Discuss and devise some appropriate land use plans that take into consideration increasing human population, human needs and desires for land and the needs for saving and recreating space for non-human communities.

The Food Web in Your Prairie

Source: Robin Greenler
Subject: **Science,** art, language arts
Grade: 3-8
Summary: Students observe a step in a food chain and begin to reconstruct an entire prairie food web.

Activity Time: In the field: 30-45 minutes. Classroom discussion: 30-45 minutes.
Materials: index cards or small paper, chalkboard or large paper
Season: late spring, summer, fall

Activity: After a discussion about food webs, have students go out in the prairie and find signs of two steps in a food web. (This can be done singly or in groups.) These steps can involve the sun, plants, insects, birds, mammals, decomposers, etc. Draw or describe the interaction on a card. Gather all the cards from students and lay them out on a chalkboard or large piece of paper. Draw lines between cards as appropriate to create the start of your prairie food web. Cards can be hooked together with pipe cleaners or string. Discuss which parts are missing and put those in.

From Soil, To Soil

Source: Robin Greenler
Subject: **Science, math, social studies (extension)**
Grade: 6-12
Summary: Students estimate the natural rate of organic addition in prairie soils and compare to the artificial organic supplementation in agricultural systems.

Activity Time: Field measurements and calculations: one hour. Discussion: 10 minutes.
Materials: measuring sticks or tape
Season: fall

Activity: Addition of organic matter to soil enhances soil quality in many ways. Organic matter increases water retention in sandy soils and increases drainage for clay soils. In addition to increasing the nutrient levels directly from addition of nutrient-rich plant matter, addition of organic matter allows the soil to bind the nutrient ions more effectively, thus decreasing nutrient leaching. Finally, organic matter improves the tilth, or texture, of the soil by making sandy soils hold together better and clay soils become more porous. Both of these changes in texture allow more air and water into the soil and decrease wind and water erosion.

In a prairie, approximately 90% of a plant's total biomass is underground and approximately 33% of a plant's root biomass sloughs off into the soil each year. Estimate the above- and below-ground biomass in your prairie or a local restoration or remnant (see the activity entitled "Bulking Up"). Using these figures, estimate the biomass and total organic matter added to the soil from both the plant roots and tops. Discuss the role of soil organic matter for water retention.

Social Studies Extension: Interview farmers to find what organic matter is added to agricultural soils in production. The two types of organic matter inputs are generally the "crop residue," that is, the amount of plant left on the field, and additions such as manure. Estimate how much organic matter the inputs represent. If possible, interview an organic farmer who uses cover cropping and determine organic matter added to soils through a cover cropping system. Compare to natural addition from prairies. Remember that prairies add more organic matter and create richer soils than almost any other ecosystem on earth.

The March of the Prairie

Source: Robin Greenler
Subject: **Science, math,** language arts
Grade: 5-12
Summary: Students observe the phenological sequence of events on a prairie as the seasons change.

Activity Time: requires regular periodic visits for observation; exact time depends on design of activity
Materials: none
Season: any possible; generally spring, summer and fall

Activity: Something is always happening on a prairie. Generally the events of a year unfold in a natural sequence of one leading to the next. These events follow seasons and weather but not necessarily calendar dates. Aldo Leopold's Sand County Almanac chronicles a fascinating phenological sequence in a prairie region and provides excellent reading for students. These phenological sequences provide numerous opportunities for observation and study. The best known and most dramatic sequence involves the prairie plants blooming from mid-May through mid-October, as one blooming plant wanes and another takes center stage. However, there are many other phenological sequences that students can observe. Unfortunately, the timing is such that some of the drama unfolds during summer vacation.

The challenge of involving students in phenological studies with a school-year schedule has been addressed in numerous ways. One can focus on the spring, fall or winter portion of the season exclusively. For plant-related studies, late August through mid-October is generally richer than mid-May through June, but other phenological sequences are visible throughout the year. If a summer school class or extra-curricular club can take on a phenological study during a small portion of the summer, this can often serve as a bridge between the spring and fall observations. As a last resort, numerous phenological studies on prairies have been published and these can fill in the gap between the spring and fall or for the first portion of the sequence, which is then picked up in the fall by observation.

In addition to observations, students can be encouraged to write a journal, log or essay of their observations. Below is a list of some phenological sequences that students can examine.

Blossoming flowers by species See the following activity, "Blooming Time," for details of how to determine a sequence of flowering plants on the prairie.

Colors of blossoming flowers Is there a sequence of colors throughout the season?

Insect life Is there a sequence of insects in general or of active pollinators?

Geometric shapes Examine the geometric shapes of flower blossoms. Is there a sequence to these shapes or are the

proportions of flowers' shapes consistent throughout the season? What significance does shape have for insect pollination, wind tolerance, sun and water?

Seed dispersal mechanisms? Is there a phenological sequence with respect to dispersal mechanisms such as wind, fruit/berry or stick-tight dispersal?

Seed size and weight Does seed size, weight or average number of seeds per plant vary phenologically?

Math extension for grades 6-8: Graph the phenological sequences observed as a line or bar graph or series of pie charts.

The Niche Kit

Source: John Greenler, Robin Greenler, The Bottle Biology Project
Subject: **Science,** language arts
Grade: 3-8, extension 9-12
Summary: Students examine and describe a single niche and then, put all the niches back together into an entire system.

Activity Time: 45-60 minutes
Materials: 6-12 film canisters filled with small bits of material from prairie, hand lenses (optional).
Season: spring, summer, fall

Activity: The teacher should find an area on the prairie restoration that represents an edge or transition between two ecosystems such as the edge between the prairie and lawn, woods or water. Collect small bits of material that represent different, recognizable niches from those systems (one niche in each film canister). These could include things like leaf litter, dark upper-level humus soil, moss, seeds from a grass stalk, grass, soil from lawn with grass roots, bark from a tree, leaves, moist water-edge soil, surface water, etc.

Pass out one film canister to a group of 2-4 students and have them examine the contents. Provide a hand lens. Each group then addresses the following for "their" niche:

1. Name the niche. They should be creative and descriptive; they are not to identify the niche.
2. Describe the niche. Consider physical, chemical and biological characteristics of the niche.
3. List the plants, animals and insects that live in or interact with "your" niche?

Record these responses on the board.

Have one representative from each group join together. As a group, the representatives try to recreate the original ecosystem by placing themselves (their niche) in the correct place relative to the others. Once they have assembled themselves into this human "ecosculpture," have each person tell why they are where they are.

Extension for grades 9-12: Have high school students collect the niches in the film canisters and lead younger students in the activity.

A Prairie Burn

Source: Greg Bisbee
Subject: **Language arts, science**
Grade: 6-12
Summary: Students observe a prairie burn, and consider the effects of fire on prairie plants.

Activity Time: Discussion: 30 minutes
Materials: none
Season: after observing a prairie burn, probably in spring

Activity: It is thought that prairie fires were a way that prairie plants fended off invasion of brushy species, trees and nonnative species. Fire is now used as a management tool to aid in the establishment of prairie species and discourage nonnatives.

After observing a prairie burn, have students write an essay describing the burn from the plant's point-of-view. Have them consider the plant's view before the burn, during the burn, the moments and days after the burn and the rest of the season. Discuss their ideas. Include concepts relating to the role of plant roots, the effects of the fire on plant competition and soil organisms (keeping in mind that soil is an <u>extremely</u> efficient insulator) and the ability of the blackened and bare soil to absorb heat.

Prairie Interactions

Source: Robin Greenler
Subject: Science
Grade: 3-12
Summary: Students examine interactions between organisms on the prairie and consider their positive and negative effects.

Activity Time: 45 minutes minimum
Materials: none
Season: spring, summer, fall

Activity: Divide students into small groups and have each group pick a small site on the prairie to observe. Describe the plants that seem to dominate their site. Next, note each animal or animal sign they observe. Look carefully for small animal signs such as decomposition in the leaf litter, bird calls, etc. Now make a list of any evidence of interactions between two plants (one plant shading another or moss on another plant), between a plant and an animal (chewed leaves, pollination) or between two animals (scat with bones, disturbed ant mound). Finally categorize these interactions based on their effect on each other--mutually beneficial (+/+), mutually harmful (-/-) or beneficial to one and harmful to the other (+/-).

Prairie Neighbors Make a Community

Source: Georgia Gomez-Ibanez
Subject: Science
Grade: K-8
Summary: Students brainstorm on ways certain organisms contribute to the prairie community.

Activity Time: 15 minutes minimum
Materials: none
Season: any (indoors)

Activity: Pick any plant species and any season and begin a discussion with the question, "How is that plant contributing to the prairie community?" (Students may need to observe that plant in the prairie or see a photograph of it.) As students start to generate ideas, someone should write them on the board. If the teacher wishes to extend this activity, a organism or environmental component mentioned in the first brainstorm can be the subject for the next (in this way, this activity could be done daily for many days). An example might be:

"How does big bluestem contribute to the prairie community in winter?" Thoughts may include:

* *A mouse is nesting in its fallen leaves.*
* *A mouse can eat its fallen seeds.*
* *Birds can eat the seeds remaining on the stalk.*
* *Its roots are holding the soil.*
* *Its litter is beginning the process of decay, which will contribute to the soil.*
* *It helps slow the winter winds so animals living on the prairie have some shelter.*

"And the mouse? How is she contributing?"

* *When she gathers seeds she loses some. Those might be planted or might be gathered by ants.*
* *Her burrowing loosens the soil.*
* *Chewing the litter loosens up thatch.*
* *As she chews litter for nest building, the plant material is broken into smaller pieces and can more easily decay into the soil.*
* *She may eat some precious seeds that a conservationist wanted!*
* *Her droppings enrich the soil for years to come.*

Additional spin-offs from these discussions could include questions about the contributions of the birds, conservationist or the soil.

Extension:
* Review the stages of life that a person goes through and then of a prairie plant. Consider the contribution the plant is making to

the community during each stage of its life cycle.

* Review the life cycle of a butterfly (egg, larva, chrysalis and adult) and consider the contribution it is making at each stage of its life cycle.

Rather than in a discussion format, students could research a specific plant, animal or life cycle stage and report back to the class. Field guides provide good behavioral and life cycle information.

Root Growth

Source: Bottle Biology Project, Robin Greenler
Subject: **Science,** math
Grade: 6-8
Summary: Students observe root growth of a prairie grass.

Activity Time: Building initial bottle set-up: 30-45 minutes. Observations, measurement and watering: 10-15 minutes/week for 4-5 months.
Materials: five 1-liter or five 2-liter plastic soda bottles, soil, 5 big bluestem seeds, circular fluorescent light (available from most hardware stores), string
Season: start in fall

Activity: Make a bottle column as shown in Appendix 4, "Bottle Column Construction," except have the upper portion consist of 3-4 soda bottle pieces (like piece "B" in the appendix illustration) so the growing column is very long. Make certain the wick extends to the top bottle section. Cover the top column with a sleeve of dark paper. Allow the sleeve to slide so that the roots can be observed. Fill the top column with soil. Plant 5-10 seeds of big bluestem (Andropogon gerardi) on the top and cover lightly with soil. Water column until water drips through to bottom reservoir. Hang circular light about 10 cm above the soil surface. The light will need to be moved up as the plant grows. Soon the roots should be visible (roots will avoid light so the sleeve encourages roots to grow along the outside edge). Create a large graph to record weekly root growth. Water as needed.

Tip: In order to keep the column stable, use either a ring stand or temporarily velcro the column to a wall by attaching velcro self-adhesive tape to the bottle and wall.

Extension:
* Grow the plant through its entire life cycle and collect seed. Photograph the life cycle sequence.
* See the activity entitled "Prairie Plant Growth," which outlines a procedure for measuring other aspects of plant growth and setting up growth experiments using a similar set-up.

Soil Analysis

Source: Greg Bisbee
Subject: **Science,** math
Grade: 6-12
Summary: Students test many characteristics of their soil.

Activity Time: variable
Materials: soil auger (soil profile), bunsen burner, scale (moisture content and organic matter content), soil test kit (nutrient content), empty 12 oz. can (permeability), clear bottle (soil components)
Season: Spring, summer, fall

Activity: The following tests can be run to analyze your soils.

Soil Profile A good soil sample can be taken with a soil corer or soil auger. With this you can examine a soil column 10-50 cm deep. Examine the soil profile to see where the color and texture change.
Moisture Content Weigh a soil sample before and after drying. The soil can be dried on a bunsen burner.
Nutrients Tests for nitrogen, phosphorus, potash and pH can be done with simple soil testing kits. Greg Bisbee's class used a Sudbury Test Kit.
Organic Matter Concentration The procedure for this is similar to the moisture content test except the soil should be dried out until it has the texture of coal.
Permeability Pound a 12 oz. can into the soil 2 cm. Fill up the can the rest of the way with water and time how long it takes for the water to drain.
Soil Components Fill a clear bottle 3/4 full with water. Add soil to fill the bottle and let it settle for two days. Measure the different ingredients in the soil. Soil components are best reported as a percentage of the total.

Take a Look:
An Elementary Biodiversity Study

Source: Carlia Meehan, Denise Jess
Subject: **Science**, math, language arts
Grade: K-5
Summary: Students compare the biodiversity of a prairie with a lawn.

Activity Time: 1 hour minimum
Materials: cards with objects or organisms to look for
Season: late spring, summer, early fall

Activity: This activity provides students with an opportunity to investigate and compare the biodiversity of lawn and prairie.

Have students work in pairs or small groups. Choose an area of the school yard lawn and of the prairie for students to investigate. Each group will look for an assigned object such as plants taller than themselves, plants that reach the tops of their shoes, certain color or type of flower, ants, ant hills, butterflies, birds or spiders. Each student can get a card with their assigned object and a space to tally the number found. The information obtained can be shown on a large chart or graph and biodiversity in each area can be discussed.

Water Holding Capacity in Soil

Source: Bottle Biology Program (see Bottle Biology: An idea book for exploring the world through soda bottles and other recyclable materials, published by Kendall Hunt Publishing Co.)
Subject: **Science,** math
Grade: 6-12
Summary: Students measure and compare the water holding capacity of various soils.

Activity Time: Building the column: 45 minutes. Running the experiment: 30 minutes. Recording and analyzing final data: 10 minutes (must be done 24 hours after running the experiment).
Materials: two 1-liter soda bottles, one bottle cap, graduated cylinder, 500 cc of soil
Season: any

Activity: Build a soil column (see Appendix 8, "Building a Soil Column"). Add 500 cc of dry soil. Add 20 ml of water at a time until soil is thoroughly wetted and begins to drip into the reservoir below. Heavy clay soils may take a long time to saturate. Some soils resist wetting and the water will tend to channel to the bottom before the soil is thoroughly moist. Let the column sit for 24 hours to drain. Record the amount of water added to make the soil saturated, subtracting the volume that drained through. The water holding capacity can then be recorded as ml of water per 500 cc of soil. Students can perform replicates or compare different soils. Discuss the implications of a soil's water holding capacity for the plants and animals in that ecosystem. Too much water holding capacity or too little can cause problems. Which type of soils seemed to have greater water holding capacity?

Extension:
* **Determining Soil pH:** Measure the pH of the water before and after it runs through the soil column.
* Students could set up further experiments with this system by examining the effects of soil compaction, abilities of soils to absorb toxins (such as acid or salt) and leaching rates.

What's Green and Grows All Over?
An Advanced Biodiversity Study

Source: Greg Bisbee, Kathleen Morgen
Subject: **Science**, math
Grade: 6-12
Summary: Students compare the biodiversity of a prairie with a lawn or other ecosystem.

Activity Time: 45 minutes to one hour in each site
Materials: sets of four equal-length sticks or other device to mark off quadrats
Season: late spring, summer, early fall

Activity: This activity provides upper-level students with an opportunity to investigate and compare the biodiversity of different sites. Sites that would provide interesting comparisons include a lawn, an old field, a one-year prairie restoration, an older restoration or a prairie remnant. This study could also be repeated each year in a restoration to monitor the change in the restoration as it matures.

Divide the students into research groups. Give each group an index card with a large loop of tape on it and four sticks of equal length for the square quadrat. Randomly choose a spot in the prairie for the quadrat or have students choose a spot that they consider to be representative of the prairie. If an annual survey of your restoration is planned, you could have permanent plots set up or choose new ones each year.

Have students count the number of different species of plants in their quadrat. If the plants are very small, place a small leaf of each species on the tape (generally appropriate for spring studies). If the plants are large, have them sketch the leaf and note any other identifying traits. Identification is not necessary. Repeat the process in a lawn.

Determine the average number of species per plot and the total number of species by the class. In many instances, a single prairie quadrat may not have as large a number of different species than the lawn quadrats but all prairie quadrats together will reveal a far greater diversity than all the lawn quadrats. This is because prairie species tend to clump together whereas a lawn, for instance, tends to have all species distributed in a more homogeneous pattern.

Extension: Record the number of insects, spiders and larger animals in each quadrat. In addition to the animals, challenge students to become sleuths and find as many <u>traces</u> of animals as possible. Traces of animals can include decayed leaf matter, a litter layer in the soil, a gnawed leaf, a spotted or slightly diseased leaf, a flower or nectar (the flower and nectar wouldn't be there in the absence of pollinators), a spider's web, etc.

Extension for Older Students: Have students identify the plants in their plot. Identification of plants prior to blooming is very difficult but a good key should allow identification of all blooming plants.

What's in a Soil

Source: general
Subject: Science
Grade: K-5
Summary: Students dissect soils and examine the components.

Activity Time: 20 minutes minimum
Materials: soil
Season: any (whenever soil is not frozen)

Activity: Spread soil out on a table and examine the components. Divide the soil into two piles. The first contains living matter such as plants and animals (either dead or alive) and the second contains non-living matter such as rocks, stones, clay, sand, etc. Discuss what role each of these components plays. If possible, compare soil from a few different ecosystems such as a woodland, old field, lawn and wetland.

What's in the Roots?

Source: Robin Greenler
Subject: **Science**, math
Grade: 6-12
Summary: Students compare above- and below-ground biomass in a lawn and prairie and consider the implications for burning a prairie as a way to eliminate nonnative weeds.

Activity Time: 60 minutes
Materials: none
Season: fall

Activity: Dig up a small plug of lawn. Save and clean the roots. Estimate the below- and above-ground biomass in the lawn (estimate as a volume). Calculate a ratio of above-ground : below-ground biomass. Compare to the above-ground : below-ground prairie ratio of 1:9. Discuss the implications of this ratio for periodic fires. Why might burning a prairie be an effective way to eliminate nonnative weeds in a prairie?

Extension:
* Estimate the root mass below ground in a prairie using the assertion that 10% of the plants biomass is above ground (see the activity entitled "Bulking Up").
* Calculate total root length, above-ground : below-ground ratios and/or total surface root areas from illustrations of prairie plants (see Appendix 5, "Prairie Plants; Roots and Shoots").

All in the Family

Source: Kathleen Morgen
Subject: **Science,** language arts
Grade: 4-12
Summary: Students learn about the three most prominent prairie plant families in order to begin to select species to include in their prairie restoration.

Activity Time: three or more 40-45 minute class periods
Materials: field guides and other resource materials
Season: any (use mature specimens as they appear in the summer or fall)

Activity: Provide students with specimens from the grass (Poaceae), legume (Fabaceae) and composite (Asteraceae) families along with field guides which give ecological information about each plant. Have students work in groups to list characteristics of each family and reasons why each family is important to the prairie.

Have students scan the books to find at least five members for each family. Ask them to design a chart or charts where they can show comparative information such as blooming date, color, height, seed collection date, seed treatment, type of preferred site and other pertinent information for each species. Much of this information is included in the Prairie Restoration for Wisconsin Schools in a section entitled, "Species Data Base."

Based on information gleaned, ask the students to select at least three species from these families that will serve as a foundation for the prairie restoration. The final species list will include smaller amounts of other important species. For more information on developing the species mix, see Prairie Restoration for Wisconsin Schools, *A Guide to Restoration from Site Analysis to Management* by Molly Fifield Murray.

By Hand or Herbicide?

Source: Robin Greenler
Subject: **Social studies, language arts**, science
Grade: 3-12
Summary: Students consider the pros and cons of different strategies for eliminating unwanted species.

Activity Time: variable
Materials: none
Season: any

Activity: Have the students write an essay or stage an oral debate comparing the pros and cons of eliminating unwanted species by human removal versus herbicide application on their prairie. Consider issues such as cost, environmental impact (plants, animals, the restoration as a whole, soil and water), the amount of labor necessary, effectiveness and safety. Draw on a wide range of resources including those from both sides of the issue. Would they come to a different conclusion for a prairie restoration done on a private residence, by the Department of Transportation along the state highways or in an urban or rural area? Are the conclusions different with respect to herbicide use in conventional agriculture?

Developing a Public-Friendly Prairie Site

Source: Robin Greenler
Subject: **Art, language arts, science,** social studies
Grade: 3-12
Summary: Students develop signs and pamphlets that inform the public about what is happening on their prairie.

Activity Time: variable
Materials: depends on project
Season: any

Activity: Students can help make their restoration an educational setting by developing strategies to let others know what is happening on the prairie site. Students can develop, design and construct signs at the entrance to the restoration that give an overview of the project. Signs throughout the restoration can describe a plant or feature that can be observed at that point. A self-guided walking tour based on signs throughout the restoration, a pamphlet or both can help explain the site to visitors or other students. Seasonal signs, changed four times per year, can describe what is happening and what to look for during each season. Signs for the maintenance staff, such as "do not mow," are useful, too.

Gathering Gold

Source: Kathleen Morgen
Subject: Science
Grade: K-12
Summary: Students collect seed from a restoration or remnant for their prairie.

Activity Time: variable
Materials: paper bags
Season: summer or fall

Activity: Gather seeds from a local remnant, restoration or your own restoration.

Tips for Collecting Seed

1. Make sure you obtain permission from the landowner before going into any area.
2. Collect no more than 50% of the seeds of any plant or area.
3. Walk carefully and spread out from other people to avoid creating new trails.
4. Collect only one species per bag. Label each bag with species name, date collected and collection location.
5. Collect only ripe seeds.
6. Collect only on dry days.
7. Clothespin your open bag to your waist to free both hands for collecting--one to hold the plant, one to collect seeds.
8. Some seed heads (such as purple coneflower) need to be clipped and later cleaned.
9. Be sure to research proper storage and treatment for each species.

How to Count?

Source: Robin Greenler
Subject: **Math**, science
Grade: 6-8
Summary: Students compare seeding rates based on number per area versus weight per area and examine the seeding rate in their proposed restoration plan.

Activity Time: 45 minutes
Materials: prairie nursery catalogues that give number of seeds per pound for various species of prairie plants
Season: any; after determination of a seeding plan for your restoration

Activity: Planting rates for a prairie are frequently given as 40 seeds per square foot or 20 pounds of seed per acre. Obviously, seed size will make these two measurements different. Once you have begun considering a seeding plan for your restoration, have students calculate the proposed seeding rate as number of seeds per square foot and weight of seeds per acre to determine how close they are to the recommended rates and how much the two recommendations differ. (Prairie nursery magazines will give you the number of seeds per pound for each species.) Have them consider why the two methods may differ. Discuss how results may vary with each method.

Land Use History:
Examining Living History

Source: Robin Greenler
Subject: **Social studies, language arts**
Grade: 3-12
Summary: Students interview older local residents about the area's history.

Activity Time: Interviews: 1 hour minimum.
Materials: none
Season: any

Activity: In order to research the land use history on your site, interview people in the community who have lived in the area a long time. Ask them about changes in natural history, land use, population, land ownership, rural vs. urban areas, economy, employment, roads and transportation. Ask them about stories they may have heard as children from their parents/grandparents or others. Do not limit yourself to the restoration site specifically but rather try to get a context for some more specific site history you can gather later on.

The information can be written up or presented orally. Oral presentations from each student can help to form a full picture of many different perspectives of the area's history. A class project such as a display, skit or compilation of quotes could convey the findings during a prairie celebration day (see the Chapter "Integrative Activities and General Strategies," section "Prairie Festivals").

Land Use History:
Land Ownership Records

Source: Robin Greenler, Wisconsin State Historical Society
Subject: **Social studies, language arts**
Grade: 6-12
Summary: Students research the land ownership records of their school and restoration sites.

Activity Time: depends on nature of search
Materials: public library, historical society, title company
Season: any

Activity: Research the land use and ownership history of your school site using old plat maps or title abstracts. State, county or city historical societies may also have old maps or photos of the area. The following resources may be available locally at your public library, historical society or local title companies. All of the listed resources are available from the Wisconsin State Historical Society at 816 State St., Madison, Wisconsin, 53703. Although this list is tailored for Wisconsin, many parallel resources exist in other states.

General Land Office Tract Books (Series 1673)
These books record sale of land by the federal government to the first purchasers. The records include names of purchasers, amount of land purchased, legal description of property, price paid and date of purchase.

"The Native Vegetation of Wisconsin at the Time of the Ordinal Land Survey"
This map by Robert W. Finley (D GX902 F51) shows the pre-settlement vegetation of Wisconsin based on information in the Surveyor's Notes (Series 701).

Wisconsin Land Economic Inventory (Series 1956, 1958, 1959)
This was a joint project of the University of Wisconsin and the Wisconsin State Department of Agriculture that extended from 1929 into the 1940s. The inventory surveyed the current and potential use of land throughout the state. Among the results of this survey are three sets of detailed maps.

Wisconsin Archeological Atlas
This atlas is a compilation of notes on Native American archeological and historical sites in the state. It is not a complete inventory of Native American sites but shows features such as village and camps, mound groups, burial sites, gardens, quarries and battlefields.

Plat Maps and Atlases
These are usually restricted to one county and show names of rural

landowners and boundaries of individual properties. Plat maps and atlases of the nineteenth century often include illustrations of individual farmsteads and business premises, maps or cities and villages, and locations of schools and cemeteries. Twentieth-century versions are generally much simpler.

Sandborn Insurance Maps

Sandborn maps are extremely detailed and large-scale maps of cities and villages ranging in date from the 1800s to the 1970s. These maps show the exact size and placement every building on each block and its use. Most cities were mapped several times at five- to 10-year intervals.

Land Use History:
Land Surveys

Source: Robin Greenler, Wisconsin State Historical Society
Subject: **Social studies, language arts,** science
Grade: 6-12
Summary: Students learn of the original land surveys and research the survey notes for their school and restoration site.

Activity Time: depends on nature of search
Materials: public library, historical society
Season: any

Activity: In the early 1800s, much of the value of the United States' Treasury was its land resources. However, little was known about what land really belonged to the new country. From 1830-1879 a massive national effort was launched by the U.S. General Land Office to employ surveyors to survey and map all the land in the Union. Information from the land surveys done in the 1800s often lends valuable insights into what was on the land at that time. This information may be available from your local library and the state commissioner of public lands and, for Wisconsin, the Wisconsin State Historical Society at 816 State St., Madison, WI 53703. The following list of resources is available from the Wisconsin State Historical Society.

General Land Office Survey Plats (Series 698)
A product of the original land surveys, these maps of individual townships include basic topography and some cultural features such as roads, trails, Native American sites, mines, dams and cultivated areas.

General Land Office Surveyors' Notes (Series 701)
The General Land Office Surveyors were required to make notes about the soil, vegetation and cultural features they observed as they carried out the surveys. These notes are in the form of small notebooks arranged by township. They are generally available on microfilm.

United States Geological Survey Topographical Maps
The Geological Survey mapped land from the late 1890s through the mid-1980s. The first two series of surveys cover only a portion of the state while the last, done from the late 1940s to the present, covers the entire state. They are extremely detailed and accurate topographical maps that include contours, elevations, place names, and vegetation and civil boundaries.

Map Skills

Source: Robin Greenler
Subject: Social studies, math
Grade: 5-12
Summary: Students learn map-reading skills by navigating themselves through a prepared course.

Activity Time: 30 minutes minimum
Materials: map, compass, if desired
Season: any

Activity: To familiarize students with maps and map reading, have them navigate through a course using a prepared map. Hidden checkpoints on the course can ensure students navigate the course correctly. Depending on the student level, the map can include visual markers, compass directions, coordinate readings and distances (can be estimated in strides). The maps can be visual representations or written descriptions.

Mapping Your Restoration Site

Source: Molly Murray
Subject: **Social studies, math,** science
Grade: 6-12
Summary: Students produce a map of the perimeter, buildings, human structures, vegetation, slope and sun/shade conditions on the proposed prairie restoration site.

Activity Time: 2 hours minimum
Materials: measuring tape
Season: any

Activity: Mapping the proposed restoration site is critical to all subsequent phases of the restoration project. Students should map their site in order to become more familiar with it so they can then make informed decision about species mix, planting and the management plan. Students from different grades can be involved in different portions of the mapping project or can even work together in teams.

A convenient way to begin mapping a site is to set down two perpendicular baselines, one east-west and one north-south. These baselines should run the length from one edge to the other of your restoration site. Once these lines are transferred to a map (graph paper works well), all other points can be measured off them and then drawn on the map. It is not important where the baselines are located; however, once they are drawn, they must remain marked until the mapping is over. For this reason, it is wise to place each baseline such that it can be recreated in the future (for instance, the line can originate at the corner of a building or large tree).

After the baselines have been established, the following features can be mapped. Mapping features on separate, but identical, maps allows them to be transferred to overheads and overlain.

Existing Structures: Map all existing buildings, roads, sidewalks, paths, above- and below-ground utilities, water sources for irrigations and drainage from building roofs.

Sun/shade Patterns: Map the sun and shade pattern on the site. Areas can be defined by the percentage of daylight hours the site receives in a given season. The site can be divided into small sections and groups of students can be responsible for each section. The section should be observed hourly throughout a day.

Vegetation: Map all major vegetation on the site. You can identify it with a key or sketch it for later identification. Younger students could map the vegetation based on major groupings such as grasses, forbs, shrubs and trees. Teams of mixed aged students could work together with different groups of students

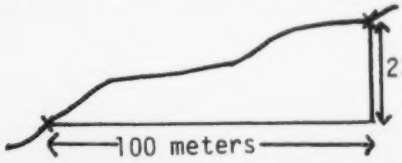
measuring distances, identifying species and recording data.

Measuring Slope

Source: Robin Greenler
Subject: Math, science
Grade: 6-12
Summary: Students measure slope on their restoration site.

Activity Time: 45 minutes
Materials: 2-meter sticks, level or marked glass of water
Season: any

Activity: Slope, or steepness, of the land is important for determining susceptibility to erosion, especially caused by water runoff. Different prairie species are recommended for planting on an area with significant slope. Slope is generally defined as the amount that a land surface rises or falls expressed as a percent.

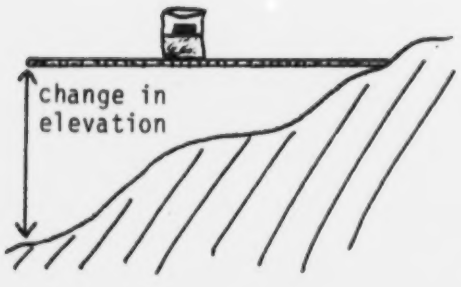


$$\frac{23 \text{ meters}}{100 \text{ meters}} \times 100 = 23\% \text{ slope}$$

The equation for determining slope, therefore, is:

$$\text{slope (in percent)} = \frac{\text{change in elevation}}{\text{measured distance}} \times 100$$

To measure slope, the students should select an area that seems to represent the average slope of the land surface selected. Place an end of a meter stick on the slope to be measured, holding it approximately level. Place the level or a glass of water on the meter stick and level off the stick. (With the glass method, fill the glass partially with water, set on a level surface and place a line of masking tape along the level line of water.) Measure the distance from the end of the level meter stick down to the ground. This measurement is the "change in elevation" and the "measured distance" is 100 cm (1 meter). See illustration.



$$\frac{\text{change in elevation}}{100 \text{ cm}} \times 100 = \text{slope}$$

Plant Immigrants

Source: Robin Greenler
Subject: **Social studies, language arts,** science
Grade: 3-12
Summary: Students learn about the introduction of nonnative plants to the New World.

Activity Time: variable
Materials: A resource for identification of nonnatives is Courtenay, Booth and Zimmerman, James, Wildflowers and Weeds (Simon & Schuster, New York).

A resource for origins of specific nonnative species is Gleason, Henry A. and Arthur Cronquist, Manual of Vascular Plants of Northeastern United States and Adjacent Canada (D. Van Norstrand Co., New York).

This text would be available at any college or university library.
Season: Identification is best done in fall; research and discussion can be done any time.

Activity: Identify the nonnative plants on your restoration plot. These nonnatives are plant species that were introduced from other parts of the world and are often aggressive and can out-compete the native plants in the region. Are the nonnatives always undesirable?

Research the origins of the nonnative plants. Have the students make a world map, individually or as a group, that shows where the nonnatives came from and the approximate dates. Are certain areas of the world more common "donors" of nonnative plants? Construct a time line or graph that shows the number of plants introduced over history. What historical events correlate with the introduction of nonnative species?

Extension:
* What are the implications, for the modern world, of plant-seed "hitchhikers" being carried all over the world?
* Research cases of exotic plant or animal introductions, both intentional (kudzu or water hyacinth in the southeast United States) or unintentional (sea lamprey in the Great Lakes). Consider the case history and biological results.
* **Language arts:** Have students compose an essay about a seed's journey to the New World from its native home.

Pollution Test Cards

Source: Denise Jess
Subject: **Science, social studies**
Grade: 3-5
Summary: Students compare air pollution at potential restoration sites.

Activity Time: Initial whole-group discussion and brainstorming: 20 minutes. Experimental set-up: 20 minutes. Daily checking of pollution test cards and logging of results: 10 minutes. Summary of results in cooperative groups: 10-15 minutes. Closing whole-group discussion of findings: 30 minutes.
Materials: For each group: 1 index card, 1 ziplock sandwich bag, marking pen, hand lens, masking tape and string, petroleum jelly. For each student: log sheet.
Season: any

Activity: As a class, discuss how air pollution might affect a prairie. Develop a list of possible restoration sites. In groups of 2 or 3, students choose a test site to monitor. Mark the location and group members' names on the index card, place the card in the bag and seal. Spread petroleum jelly on the side of the bag in which the blank side of their index card may be seen. Hang or tape the cards in the test location.

Each group receives a log sheet for their results. They should write down their prediction about the amount of air pollution they think they will see and if they think this would be a good location for a prairie restoration.

Each day the students check their card with a hand lens to see if any air pollution particles have collected on it. They should count the number of particles in three randomly selected magnifier views, and record their observations on their log sheet. At the end of the week they should report their findings to the class. Did their predictions match their results? If not, why not? Discuss the types of air pollution that might not be visible on the card. Are all equally harmful? (Note: some, like dust from nearby agricultural fields, may not be harmful at all.) Can you identify the probable source for any of the particles? Based on results from the entire class, which site has the best air quality for a restoration? Discuss the importance of air quality as only one of a number of factors which must be examined.

Prairie Math

Source: Joy Redmon, Joan Field
Subject: Math
Grade: 3-5, can be modified for K-8
Summary: Students use math to solve story problems related to their prairie restoration.

Activity Time: depends on design
Materials: worksheets
Season: any

Activity: While the following problems are appropriate for third through fifth grade students, they can be easily modified to suit the math skills of students in K-8. More importantly, the problems need not be hypothetical; they can be modified to relate directly to the restoration process of each school.

1. Carlos and Joan's classes collected prairie dock seeds at the arboretum. Carlos' class collected 1/3 of the seeds from their plant and Joan's class collected 1/4 of the seeds from their plant. The total number of seeds on the prairie dock plant for Joan's class was 24. How many seeds did they collect?

Carlos' class left 16 seeds on their plant. How many did they collect?

2. The second graders collected 100 tick trefoil seeds. They collected twice as many yellow coneflower seeds. How many yellow coneflower seeds did they collect?

3. Joan's class collected 30 seeds. 1/6 of the seeds were blazingstar seeds, 2/6 of the seeds were tick trefoil seeds, and 3/6 of the seeds were hog peanut seeds. How much of each type of seed did they collect?

4. In early spring the class counted 35 blooming spiderwort plants in the school prairie. Next they counted frostweed plants. If they counted 82 plants altogether, how many frostweed plants did they count?

5. The students wanted to put pasque flower seeds into their prairie garden. 10 seeds came in a package and 6 packages came in a box. If they bought 4 boxes of seed, how many pasque flower seeds did they buy?

6. One side of our square prairie garden measures 23 feet. What is the perimeter of our prairie garden?

7. The school has planned a bake sale to raise funds for our $128.00 prairie garden. If we can make $45.00 at each sale, how many sales will we need to pay for our garden? How much money will we have left?

Prairie Mural

Source: Robin Greenler
Subject: **Art, science**
Grade: 3-5
Summary: Students create a prairie mural by gluing seeds onto an accurate drawing of the corresponding prairie plant.

Activity Time: 1 hour (after seeds have been collected)
Materials: prairie seed, paper, drawing implements
Season: fall

Activity: This activity is only appropriate if one has an abundance of prairie seeds, since planting seeds for the restoration should always be the top priority. Students create a large group mural of the prairie. They draw a plant they have collected seed from and glue the seeds on the mural in the appropriate arrangement. Alternatively, each student could draw one prairie plant (with appropriate seeds) and glue that onto the large prairie mural.

Extension:
* Students could make a progressive mural or calendar by collecting seeds weekly and drawing the plants (with seeds) that they find each week.
* Each student researches a specific plant and creates a vertical banner of that plant. The portrait of the plant can be done by crayon rubbing, solar graphics, colored field guide picture, photograph, or pressed flower/plant. The upper, above-ground portion of the banner can be done on white paper with the lower, underground portion on brown paper. The banners can be beautifully displayed in the school hallway.

Prairie Plant and Seed Prices

Source: Christina Mandt
Subject: **Math,** science
Grade: 3-12
Summary: Students determine prices for various prairie restoration plans based on current prices.

Activity Time: variable
Materials: worksheets or current seed and plant prices from prairie nurseries
Season: any

Activity: A major consideration in designing the species mix for a prairie restoration is cost. This activity provides an opportunity for students to use math to calculate restoration plan costs. All cost information necessary for these calculations can be found in prairie nursery catalogues. In some cases, companies may be willing to give classrooms multiple copies of last year's catalogues.

For students in grades 3-8 Develop a worksheet that involves story problems. The story problems can include total cost of an order given the prices and desires (in the form of a mock order sheet), questions about the money saved by various students collecting quantities of seeds, the cost per seed (given cost per ounce and number of seeds per ounce) or the number of ounces of different seeds needed given a seeding rate of 20 pounds of seed per acre or of 40 seeds per square foot.

For students in grades 4-12 Students can reconcile the species list developed by the classroom and available budget and come up with a purchase plan that includes seed and plant purchase, seed collecting and growing transplants.

Prairie Visions

Source: Kathleen Morgen
Subject: **Language arts, art, social studies,** science
Grade: 3-12
Summary: Students reflect on why they are doing a prairie restoration.

Activity Time: Prairie visits, travel and project time varies.
Materials: depends on project
Season: any season possible; late spring or early fall are best

Activity: As your class considers creating a prairie planting, visit a prairie restoration or remnant. Have the students create a project to reflect their vision for the future. Project suggestions include:
1.) Write a letter to your great-great grandparent or great-great-grandchild. Tell them what you are doing today to restore prairies and why.
2.) Create a poster entitled, "Prairie Visions." Include past, present and future.
3.) Make a list of the changes you think will be necessary to make sure prairie remnants are saved and enlarged.
4.) Form a committee to plan a fund raising event for your school prairie restoration project.

Restoration Documentary

Source: Kathleen Morgen
Subject: Art, photography, special or individual project
Grade: 5-12
Summary: Students create a photograph series or video to document the restoration effort.

Activity Time: depends on project design
Materials: camera and film or video camera and editing equipment
Season: any

Activity: Have students develop a video that captures the restoration process. The process could be broken into sections and different students could develop each section. Sections might include the biological background, the site work, the planning behind the work, the educational uses and plans for the prairie, the involvement of different ages, etc. This is especially powerful if the entire school is involved with the effort.

Site Preparation: What Works?

Source: Robin Greenler
Subject: **Science**, math
Grade: 3-12
Summary: As a restoration site is prepared, students set up experiments to determine the effectiveness of different site preparation techniques for eliminating unwanted species.

Activity Time: variable
Materials: depends on design
Season: depends on design

Activity: There is little hard data on the effectiveness of various site preparation and exotic species control techniques. As a restoration is planned, experiments can be set up comparing different methods of site preparation. Experiments can focus on overall site preparation by looking at mulching, herbiciding, tilling or a combination. Species control experiments can also focus on the elimination of a specific unwanted species by comparing removal, cutting, girdling, mulching, tilling or herbicide application. Different timing of a given site preparation or species control measure can be compared. Data from these long-term experiments can be gathered annually by successive classes and compared.

Tree Height

Source: various
Subject: Math, science
Grade: 3-12
Summary: Students determine tree height using estimates, proportions or trigonometry.

Activity Time: 15-30 minutes per method
Materials: Logger's and Shadow: measuring tape. Sighting: measuring tape, 10" stick. Trigonometry: measuring tape, protractor, log tables or calculator with log functions.
Season: any

Activity: Measuring tree height is an important part of general site analysis. The following methods for measuring tree height can be used at different grade levels or can be compared for accuracy.

Rough estimate (3-12) Have a person of known height stand by a tree and have students stand back and estimate how many "heights" of that person make up the tree height. Compare estimates.

Logger's estimate (3-12) Standing a distance from the tree, put your arm at full arm's length and bracket the tree height between your thumb and forefinger. Without changing the distance between your fingers, rotate your hand so the distance runs along the ground from the base of the tree outward. Have a second student locate the spot on the ground identified by your forefinger. (Note: it is important to keep your arm at full arm's length throughout this exercise.) The distance on the ground equals the height of the tree.

Shadows (6-12) Measure the shadow length of the tree and of a student of known height. The tree height can be calculated by the following proportion:

$$\frac{\text{height of tree}}{\text{length of tree's shadow}} = \frac{\text{height of person}}{\text{length of person's shadow}}$$

Therefore,

$$\text{the height of the tree} = \frac{\text{height of person x length of tree's shadow}}{\text{length of person's shadow}}$$

Sighting a Ruler (6-12) Using a 10" stick with 1" marked off, move a distance from the tree such that, if held at arm's length, the stick just "covers" the height of the tree. In this position, sight through the 1" mark to the tree. Have your partner mark this "1 inch" position on the trunk of the tree. Measure the distance from the "1 inch" position to the ground. Tree height can be

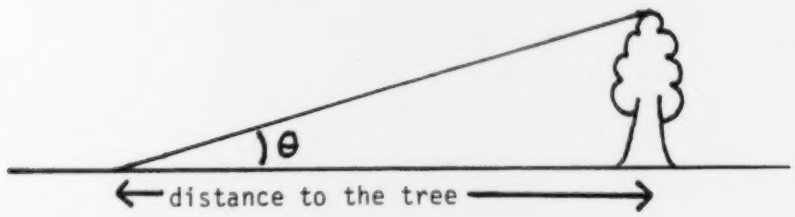
calculated by the following proportion:

$$\frac{1"}{10"} = \frac{\text{distance from the "one inch" position to the ground}}{\text{height of tree}}$$

Therefore,

the height of the tree
= distance from the "one inch" position to ground x 10

Trigonometry (9-12) Measure a distance from the tree and the angle necessary to sight to the top of the tree.



Calculate the tree height using the following equation:

$$\tan \text{ of angle } \theta = \frac{\text{length of leg opposite angle}}{\text{length of leg adjacent angle}} = \frac{\text{tree height}}{\text{distance to tree}}$$

VII. Integrative Activities and General Strategies

This section is somewhat different from the rest of the activity guide. Rather than focus on specific activity ideas, it outlines a number of broad activities related to the prairie that can be used to integrate many different subjects, prairie concepts and grade levels. The scope of these activities can range from a single class session to a full-school, year-long project. Rather than outline a specific approach for each of these, we have chosen to describe the broad idea, include examples from other teachers and let you, the teacher, create the specifics.

Observations, Journals and Poetry

An important first step in studying or restoring prairies is to get to know the ecosystem. Most students, as well as adults, have had no first-hand experience with prairies and possibly little contact even through indirect sources. While background material is important, students must have an opportunity to experience the prairie.

Simply going out and sitting in a prairie restoration or remnant is not likely to hold attention or prove useful to a significant degree. Students need to be given some direction and focus as well as some space to personalize the experience. Below are three strategies for encouraging personal reflection on the experience.

Observation

The simplest strategy is to guide students to observe what is going on around them. Some strategies for directing observations include:

* Pick one spot and observe it on many different occasions.
* Pick one plant and observe it carefully (once or over time).
* Look for a certain trait (plants with blue flowers, plants that are as tall as your knees, insects pollinating, etc.).
* Create an observation sheet. Georgia Gomez-Ibanez, a teacher at Cambridge Elementary School, Cambridge, Wisconsin, uses a sheet that has a space for the date, weather, a drawing of what the student looked at and lines for writing things the student noticed. A teacher from Leopold school in Madison, Wisconsin, created an observation book that included spaces for temperature, precipitation, kind of day and a list of observations made.
* Create a list of descriptive words relating to the ground, plants, animals and weather.
* Examine a place, organism, process or other phenomenon and develop a testable question (or list of questions). This can be a first step in a student's independent research project.

Journalling

Students can make and keep a journal in which to record their experiences and observations about the prairie. The journal can be used as a personal space to include thoughts, feelings and reflections; as a more academic record book and include essays, phenology records and data; or as a scrapbook and include news clippings and photographs. (Perhaps a mixture is most productive.) Assessment of a journal activity can be based simply on

participation in the process or students can be assessed individually based on growth or change in awareness, effort, knowledge and skill.

The following guidelines for development of a prairie journal were developed by Denise Jess of Wingra School in Madison, Wisconsin. While this is geared toward the 7- through 9-year-old students that Ms. Jess teaches, many of the guidelines can be adapted to other age groups and skill levels.

1. Make journals with students rather than having them use a notebook. Because the journal is their own creation, their investment in the journalling process tends to be much higher. Any bookmaking technique can be used. A quick and easy technique is to decorate and laminate a file folder. Three-hole punch it and fasten with paper fasteners, yarn or metal hoops.
2. Before going into the prairie to journal, discuss the purpose of keeping a journal and brainstorm a list of possible journal entries. Have students pick a special place to which they will return on each visit. As this is to be a private reflection time, students should be encouraged not to sit near one another.
3. Initially, set a topic for the day's writing to get students into the swing of journal writing. Offer a variety of choices such as poetry writing, story writing, feelings or emotion writing, sketching, looking for shapes, drawing negative spaces, translating sounds heard into words or pictures, etc.
4. Keep your own prairie journal to work on while the students are working on theirs. This positively models the value in keeping a journal.
5. Journal for about 15 minutes at the beginning of the year and about 30 by the end of the year.
6. After journalling, meet in a sharing circle. Students who would like to share their journal entry for that day have the opportunity to do so.

Poetry

Students may write poetry to express their feelings and experiences in a prairie. Before writing poetry, it is important that students have contact with the prairie. While this is best done through a visit, some students may additionally benefit from reading or listening to books about the prairie or researching prairie plants or animals.

Many forms of poetry are useful. Free verse may or may not include rhyming. Haiku, an ancient poetry form from Japan is built on three lines utilizing 17 syllables, usually in a 5-7-5 pattern. For example, Kathleen Morgen, from Verona Middle School, Verona, Wisconsin, writes:

Indian Grass

Once upon a time
you brushed chins of buffalo.
Come, tickle mine now.

Another form used by Joan Field from Lapham Elementary School in Madison, Wisconsin, is Cinquian, which is as follows:

Line 1	title	(noun)
Line 2	description of title	(2 adjectives)
Line 3	action of title	(3 verbs)
Line 4	statement or feeling	(4 word phrase)
Line 5	repeated title or synonym	(noun)

A related, but simpler form, is the noun verse:

Line 1	noun
Line 2	2 adjectives
Line 3	2 "ing" verbs
Line 4	synonym

An example of the noun verse is:

Leadplant
purple, spiky
growing, stretching
Amorpha canescens

Ms. Field writes that it is sometimes useful for the class to generate a list of nouns, adjectives and verbs that can be used to describe prairie plants or animals.

Adopt-a-Plant

Greg Bisbee of Arrowhead High School in Hartland, Wisconsin, has his students adopt a plant or species for the school year. Each student then does activities throughout the year with their adopted species. This continuity can lead to a student developing expertise with a certain plant.

Any series of activities can be drawn together in this way. For instance, students might first research and observe a plant (see activity entitled "Flower Child"), grow and photograph its life cycle (activity "Photographic Life Cycle"), develop a model of its seed (activity "Model a Seed"), experiment to determine the stratification conditions necessary for optimal seed germination (activity "Seed Stratification") and develop an experiment based on the environmental conditions necessary for its optimal growth (activity "Prairie Plant Growth"). Many other activities described in this guide can be used in such a sequence.

Often compiling all student's results in a book, presentation series, field guides or other format then produces an impressive comprehensive overview of prairie plant life. Any age student can benefit from this approach. Younger students can develop an expertise by focusing on a single plant in their activities and sharing their work with the rest of the class. Even growing a single plant and transplanting it into the prairie can develop a sense of ownership.

Research

Having students engage in an actual research project fits in especially well with the process of restoring a prairie. Prairie restoration is itself a large experiment; the results cannot be fully anticipated and the mechanisms are not fully understood. Because of this, it provides the opportunity for students to ask good, testable questions and begin to find answers that were not previously known.

When students are encouraged to ask, develop and pursue their own questions, curiosity begins to guide their learning. They are challenged to hone a diverse set of skills including logical and integrative thinking, writing and design.

The first and perhaps most challenging step in the process is posing the question. Younger students may need significantly more guidance in this, although all students will need some help. However, to the extent possible, let the students frame their own questions. Questions need to come out of observation; seldom can one come up with a good question while sitting at a desk. Often a good observation activity can be followed up with a brainstorming on further questions.

After posing a good (testable) question, students need to design a experiment (as simple as possible) to test it. Issues of replicates and controls can be addressed. Again, as much as possible, let the students design the experiment; only guide and give suggestions.

Finally the students need to take the data, analyze it and communicate their results to others. If the experiment was well designed, data collection is fairly easy. If this part gets cumbersome or difficult, go back and reexamine the design. Communicating the results can be done in a written lab report, oral presentation or as a part of a classroom symposium.

For older students, the final step of communicating their results can be especially fruitful. Greg Bisbee of Arrowhead High School in Hartland, Wisconsin, had all students present results from their scientific studies (in this case examining stratification requirements of different seeds) at a student symposium day. A number of schools or groups of schools have started their own scientific journals that publish the results of research done by each of the students.

Students at almost any level can participate in research as a way of learning. The degree of direction given depends on each student's ability. But even with a lot of guidance, students can often still pose their own questions, design their own experiments and take their own data. For example, everyone might grow a prairie plant and be asked to develop an experiment based on changing one environmental variable (amount of light, temperature, etc.) and measure one aspect of growth (root growth rate, plant final height, number of flowers, etc.). Students would still have the opportunity to develop their own hypotheses but are given enough guidance to ensure a successful effort. Another way to give

guidance to younger students without reducing the activity to a cookbook lab exercise is for the class as a whole to define a question, design the experiment and analyze the data. In this way, a task that might bog down an individual student can still be student-led.

A number of research projects for the classroom are being developed at the University of Wisconsin-Arboretum. For more information contact Becky Brown at (608) 262-9925.

Newsletters and Other Publications

Newsletters can serve dual purposes of providing valuable educational opportunities for students while effectively reaching out to the public. Students can share their work, express opinions via editorials, write informational articles and design and layout a publication. At the same time your restoration work and long-range plans can be better understood by others. Those "others" you may wish to reach could include other students in the school or district, teacher colleagues, school/district administrators, parents, the neighborhood or the general public. Each of these audiences could contribute substantially to your efforts. Finally, the restoration process is slow and even after it is planted, prairies need at least 2-4 years before they <u>begin</u> to resemble your goal. Because of this, it is crucial that you are communicating the broader picture to those who might not otherwise understand or see it.

Other integrative publications that might involve numerous subjects, classes and grade levels include the publication of a field guide (to your restoration, to the plants, rocks, soil or natural history on your site), signs or self-guided tours on the restoration, pamphlets about the project or useful materials for younger children developed by the older ones.

Prairie Festivals

Prairie festivals can take many different forms. The audience can range from the primary students to parents to the larger community. The focus can range from community education about the restoration to school celebration of prairie history and heritage. The participants can be a single class or an entire K-12 school or district.

Kathleen Morgen, a teacher at Verona Middle school in Verona, Wisconsin, notes that students will better internalize their experience and knowledge if they have the opportunity to share it in meaningful and creative ways. As she has written about the potential for meaningful prairie festivals, she says:

> "Special projects at each grade level can result in an all-school or community prairie festival. Ask volunteer parents to help coordinate the event by inviting other community people to demonstrate and share their knowledge and talents. By helping to make baskets, yarn or rope, fried bread or apple cider, quilts or mats, candles and simple toys, young children learn to appreciate native American and pioneer heritage. Older students can help plan and present prairie art exhibits, poetry reading, slide programs, tours, research reports and dramatics. Culminate with a multi-cultural evening of legends, stories, music, food and dancing. The entire event could be a fund raiser for the restoration project."

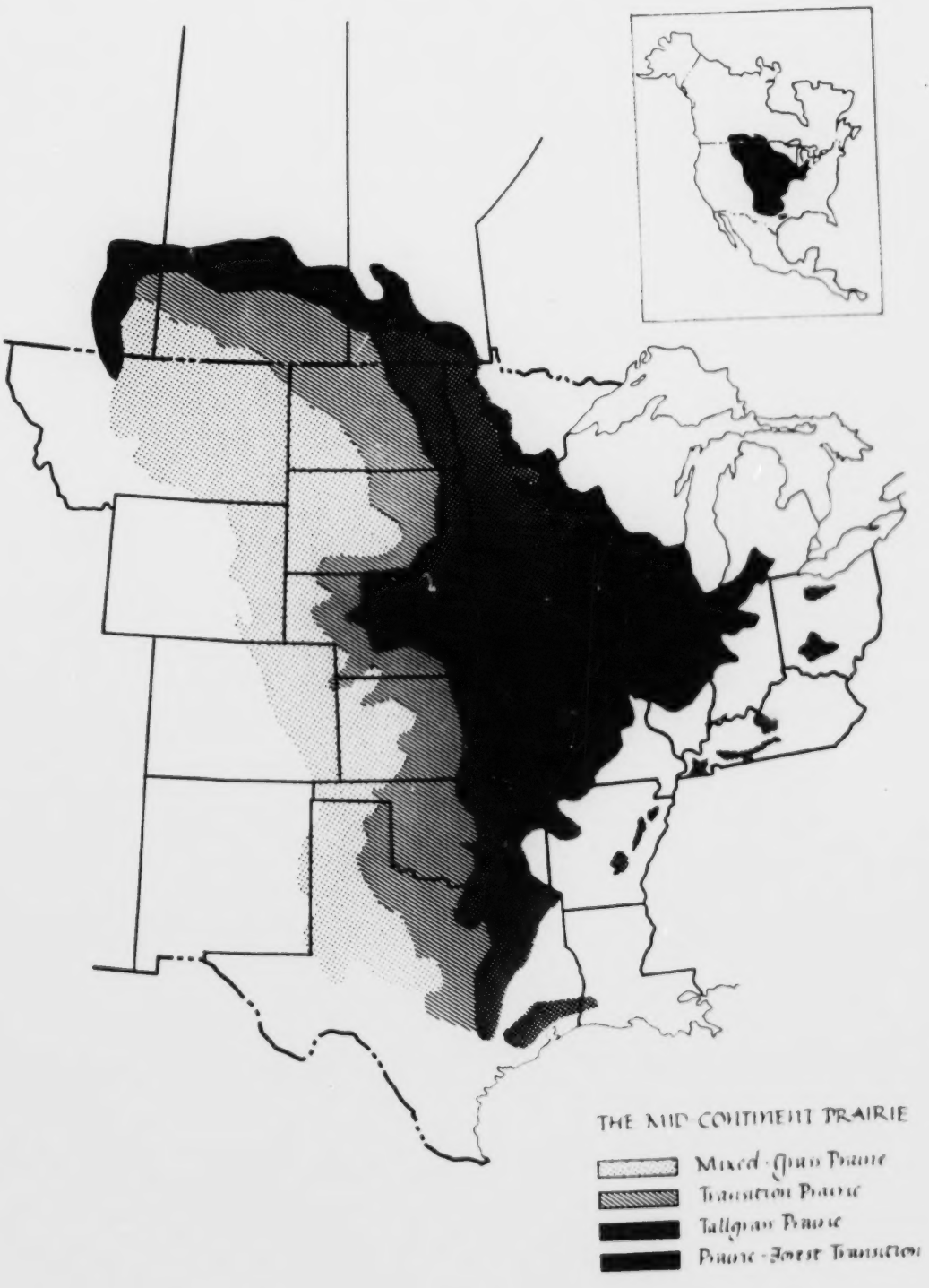
Connie Malkson of Roosevelt Elementary School in Eau Claire, Wisconsin, has her students transform the school hall into a prairie with life-sized forbs, grasses and animals. The students then take primary classes on tours through the "prairie" to see the plants and animals and hear (recorded) sounds of the prairie.

Nancy Schlimgen, a teacher from Sun Prairie Junior High School in Sun Prairie, Wisconsin, envisioned having students give guided prairie tours to the public using student-created prairie brochures. A slide show and video documenting the restoration process could also be offered.

Greg Bisbee from Arrowhead High School in Hartland, Wisconsin, had his students develop, plan, present and evaluate a community education seminar that would communicate restoration skills, methods and experiences in order to educate others interested in these activities. Another group of students developed an elementary workshop that communicated the values of the prairies and natural areas to area elementary students.

The opportunities and formats for public prairie days are endless and can involve almost any combination of activities in this activity guide. The public awareness and general enthusiasm and student ownership generated by such events are priceless.

Appendix 1: Prairie Boundaries in the United States



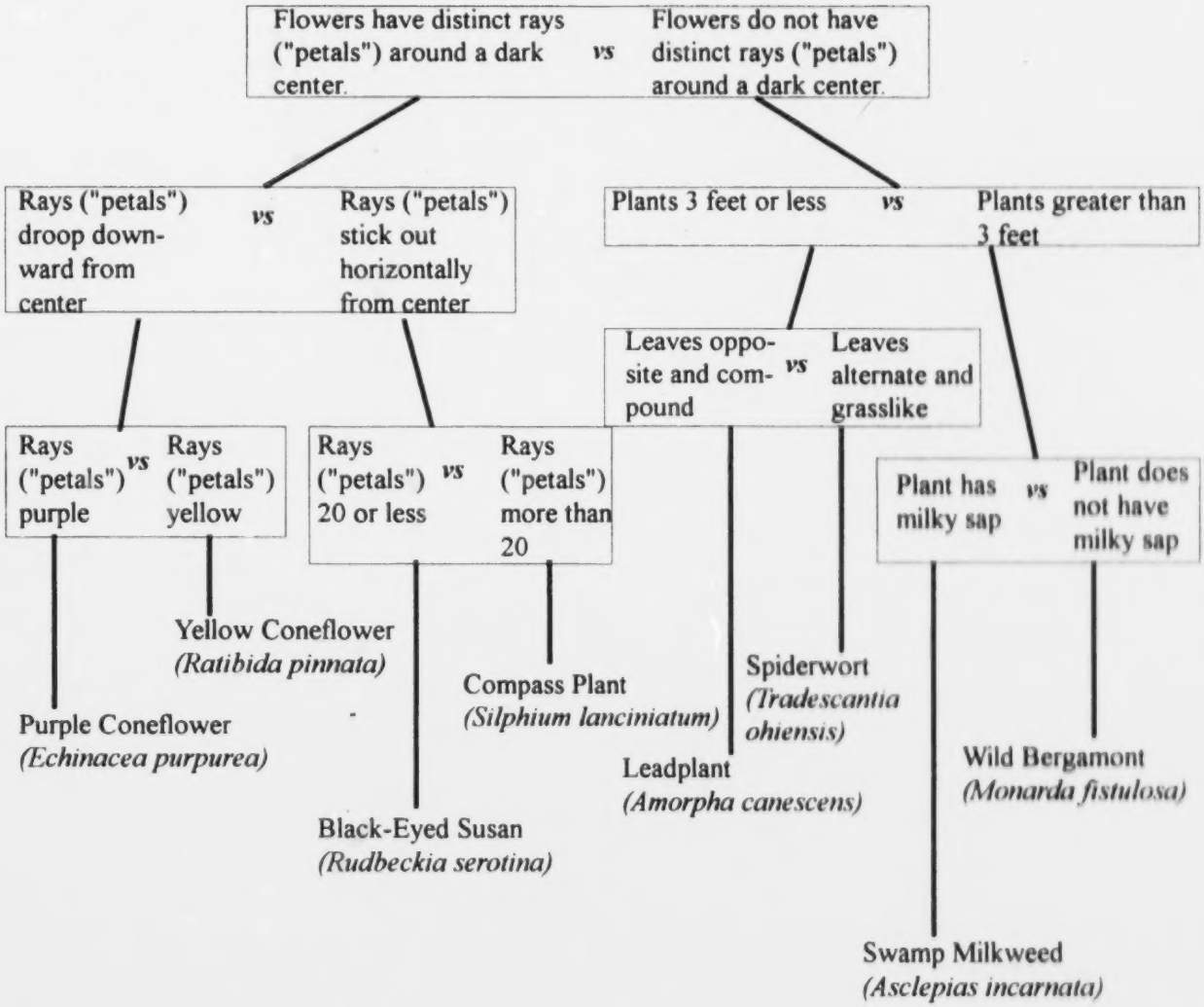
from: Costello, David F., The Prairie World, Thomas Y. Crowell Company, New York, 1969

Appendix 2:

Corn, Wheat and Grain Production in the United States

source: Goode's World Atlas, ed. by Edward B. Epenshade, Jr., Rand McNally and Company, Chicago, 1978

Appendix 3: Sample Key



Appendix 4: Bottle Column Construction

MATERIALS:

- two 2-liter bottles
- one bottle cap
- Bottle Biology Tool Kit
- wicking material — *fabric interfacing or cotton string*
- water, soil & plants

1. Remove labels from the two bottles. Remove base from one bottle, if they both have separable bases (see Bottle Basics p. 3).

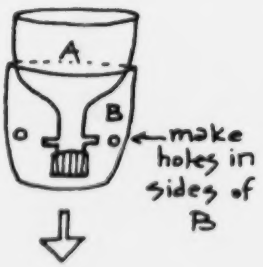
2. Cut the bottle with no base, 6-7 cm below shoulder curve, leaving a straight end on cylinder B.

Cut off the bottom 1-2 cm below hip curve, leaving a tapered end on cylinder B.

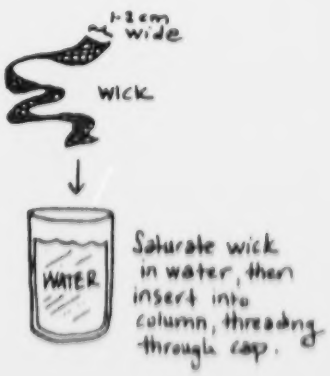
3. Cut top off second bottle 2 cm below shoulder, leaving a straight end on piece C.

4. Punch or drill a hole in cap with an awl or drill. It is very important to enlarge the hole with a tapered reamer or drill bit to about 1 cm wide, enough to easily accommodate the wick. Attach cap to A.

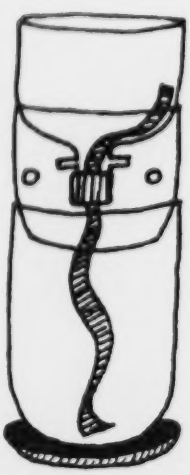
5. Invert top A into cylinder B. Tape this joint for stability. Slide A/B unit into C.



6. For wick, cut a strip of fabric interfacing 1-2 cm wide and slightly shorter than the height of the column. Insert a wet wick as shown.



When adding soil, make sure the wick runs up into the soil and is not plastered along the sides of the column or protruding above the soil surface. After you fill the column you may want to tape B and C together.



from: ***Bottle Biology: An idea book for exploring the world through soda bottles and other recyclable materials, Kendall/Hunt Publishing Company, 1993.***
For more information on the Bottle Biology Project contact The Wisconsin Fast Plants Program, 1630 Linden Dr, , University of Wisconsin-Madison, Madison, WI 53706, (608) 263-2634

Appendix 5: Prairie Plants; Roots and Shoots

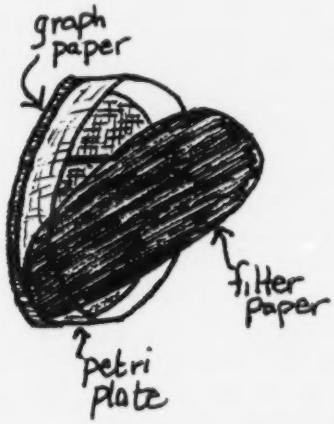
Appendix 6: Seed Germination Plate

1. Photocopy graph paper grids from next page onto a plastic transparency sheet. Cut out circles and distribute on to each student or team.

2. Distribute one filter paper to each student or team.

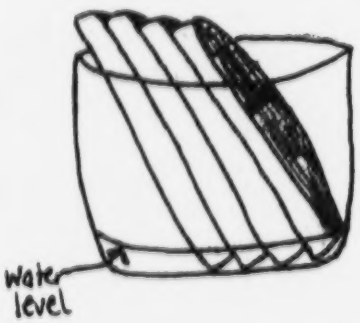
3. Moisten filter paper.

4. Tape grid to outside of petri dish and adhere the moist filter paper to the inside, as shown. (The water in the moistened paper will hold the paper to the petri dish.)

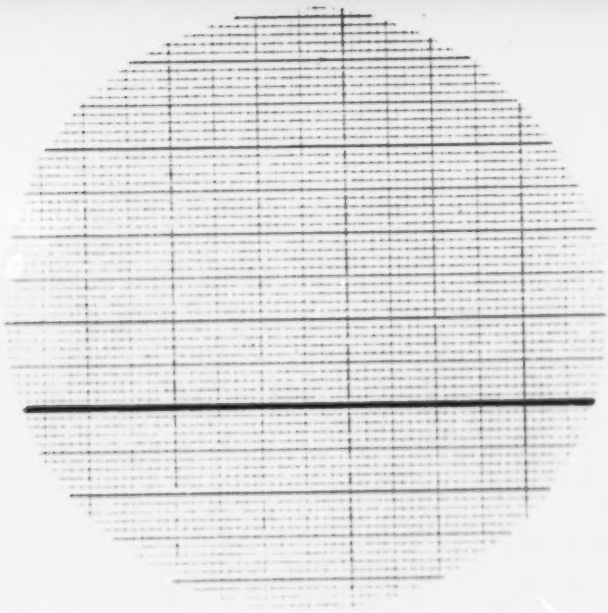
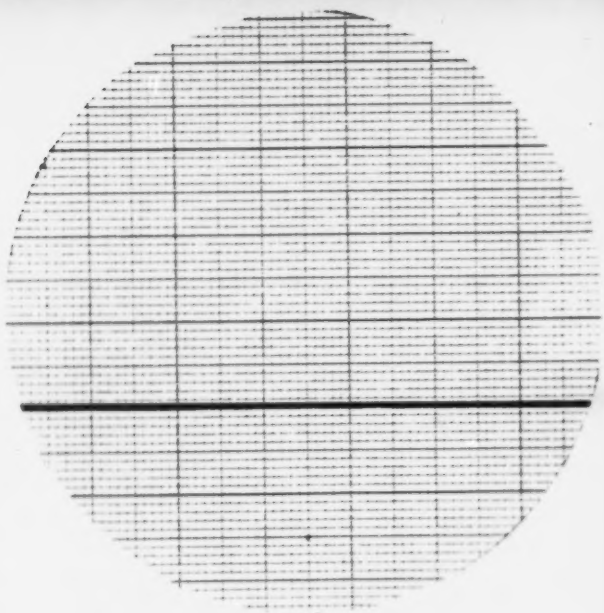
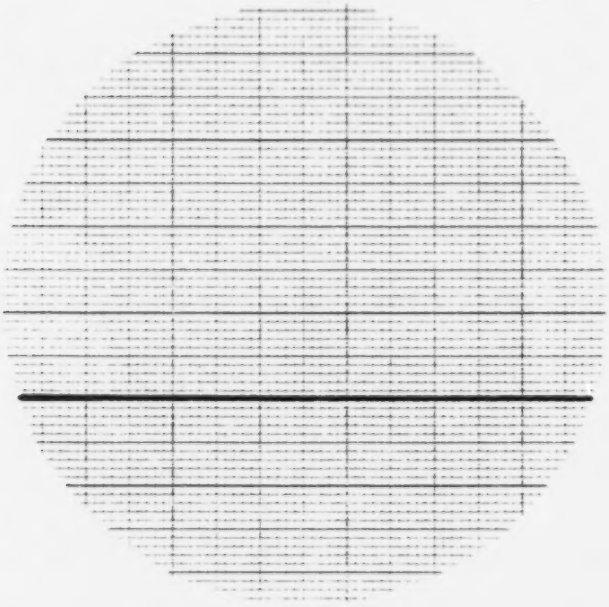
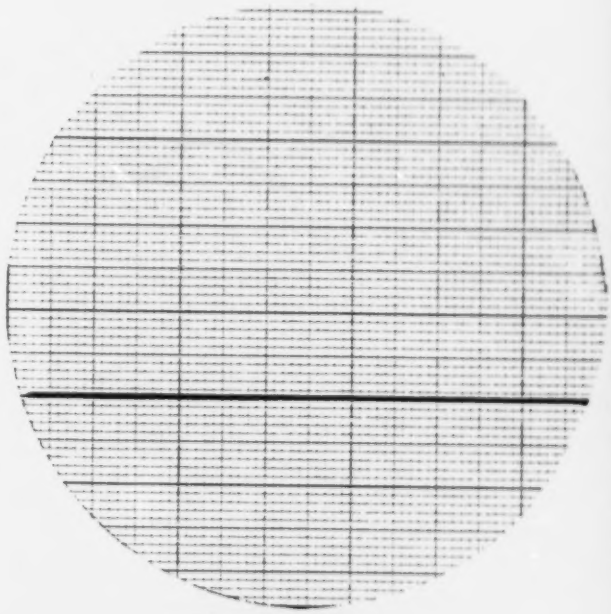
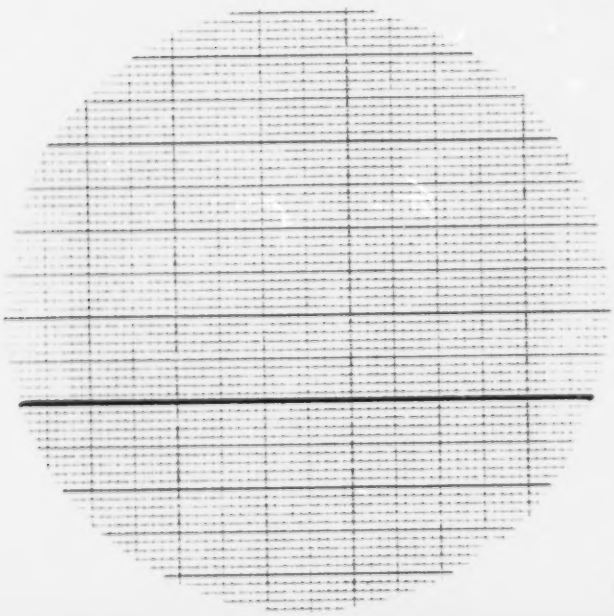
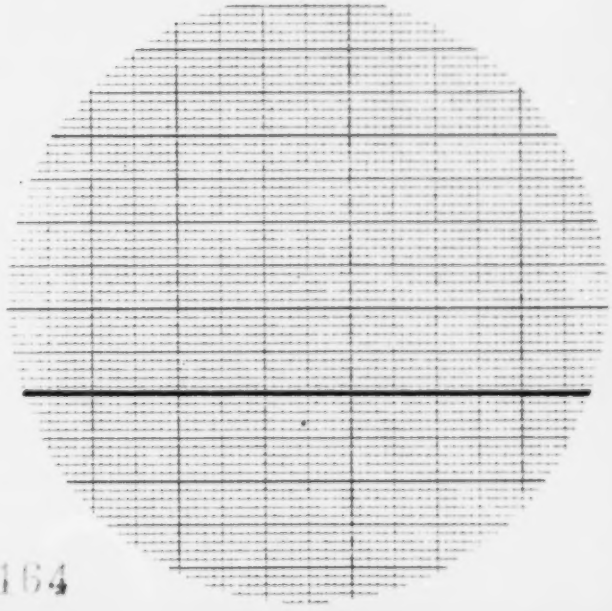


5. Attach a line of small seeds to the filter paper at the top line of the grid.

6. Cover the petri dish and place it in a plastic container so that the dishes are tilted upright and immersed in about 1 cm of water, as shown.
(The base of a two-liter soda bottle works well to hold the petri plates. The base can be removed from the bottle by heating with hot water or a hair dryer and the holes can be plugged with small pieces of electrical tape.)



From: The Wisconsin Fast Plants Program, 1630 Linden Dr., University of Wisconsin-Madison, Madison, Wisconsin, 53706, (608) 263-2634

Appendix 7: Prairie Invertebrate Study

About the Study

The Riveredge Nature Center in Newburg, Wisconsin is coordinating a Prairie Invertebrate study which will begin to examine and quantify prairie plant/invertebrate relationships. The idea is to get a handle on which insects are associated with which prairie plants. An insect's association with a plant may vary based on the insect's life cycle, plant's life cycle, time of day, season, prevalent environmental conditions, or the ecological context of the site. While this study will obviously only begin to examine the nature of the prairie plant/invertebrate relationship, it is nonetheless an important first step which is not happening elsewhere.

It is anticipated that the survey will be carried out by volunteers, lay and professional, observing in their backyard prairie or on a native prairie. If you are interested in having your students involved in such a study, please contact Andy Larsen at Riveredge Nature Center, P.O. Box 26, Newburg, WI 53060, (414) 375-2715. A data form and more information can be sent at that time. Below is more information about the project.

About the Invertebrates

Because of the difficulty of identifying all species that are found at a plant, some may wish to focus on the activity of 1 or 2 known species of invertebrates or may wish to work only with pollinators, tissue feeders, etc.

Survey Procedure Overview

1. Pick one plant and follow it through the season. Observations at several times in one day are useful as factors such as nectar flow, temperature on the leaf surface may change. Be sure of the identity of the plant species.

2. Fill out the data form for each observation and invertebrate species. Observations about what the critter is doing are as important as merely noting its presence. This will take time, so pull up a chair and settle in.

3. Observe all parts of the plant including the previous year's dead leaves and stems at the base of the plant.

4. Collect and identify each new species of invertebrate encountered. Don't worry about taxonomy but rather give it a nickname and a number (i.e. #23, blue-striped, black bug). In future observations refer to the species by its collection number and nickname. This will be challenging but is well worth it. Descriptions of "fly" or "beetle" don't help!

Lastly: Have fun--this should add a whole new dimension to the idea of "prairie watching."

Again, if you are interested in having your students participate in this study, please contact Andy Larsen at Riveredge Nature Center for more information and appropriate data forms.

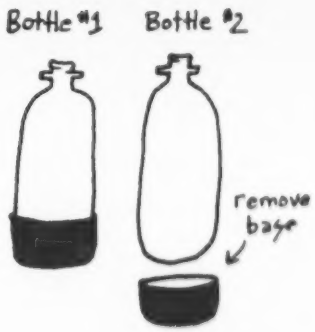
Appendix 8: Building a Soil Column

MATERIALS:

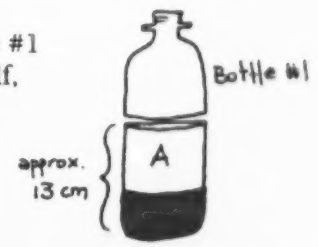
- two 1-liter bottles
- one cap
- Bottle Biology Tool Kit

- graduated cylinder
- 500 ccs soil
- water

1. Remove labels from two 1-liter bottles. Remove the base from one, if bottle has a separable base.

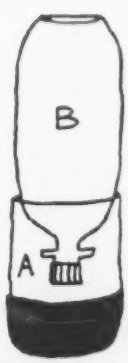


2. Cut bottle #1 roughly in half, about 13 cm from the bottom.

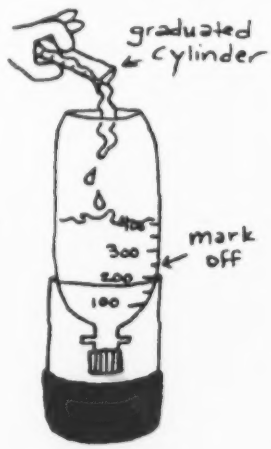


3. Cut bottom off Bottle #2, 1-2 cm below the hip.

4. Attach cap to top "B". Invert "B" into "A".

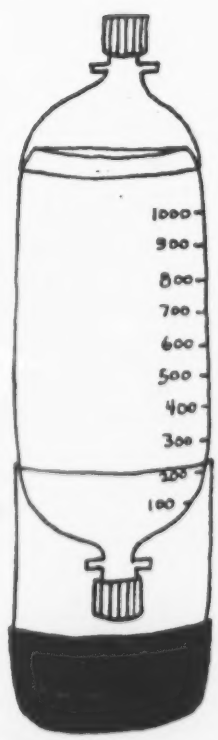


5. Use a graduated cylinder, or some other known measured container, to mark off the volume of your bottle by 100 ccs (or mls).



6. Empty bottle. Remove cap and poke drainage holes in the cap. Replace.

Use the trimmed top half of Bottle #1 as a top for the Soil Column.



from: Bottle Biology: An idea book for exploring the world through soda bottles and other recyclable materials, Kendall/Hunt Publishing Company, 1993.
For more information on the Bottle Biology Project contact The Wisconsin Fast Plants Program, 1630 Linden Dr, , University of Wisconsin-Madison, Madison, WI 53706, (608) 263-2634

Prairie Ecology and Restoration: Scope and Sequence

University of Wisconsin Arboretum
Earth Partnership Program
1207 Seminole Highway
Madison, Wisconsin 53711
(608) 262-9925

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Prairie Ecology and Restoration: Scope and Sequence

Level K-2	**Prairie Definition and Introduction**	**Human Habitation and Cultural History**	**Prairie Plants**	**Prairie Insects, Birds and Mammals**	**Ecosystem Interactions**	**Restoration**
Science		• Make and use dyes from prairie plants (19)	• Learn plant parts through "Back-to Back" movement game (25) • Variation of "Farmer in the Dell" to introduce prairie plants (36) • Create prairie grass crayon rubbings (31) • Create an identification booklet with solar graphics (42) • Grow a prairie plant (37) • Identify prairie plants from pictures (34)	• Visualize and describe life as a prairie ant (46) • Observe butterfly pollination and nectar collecting behavior (47) • Monarch Chrysalis and Butterfly: observe (52) • Discuss and sequence various life cycles (56)	• Dissect and examine prairie soil (78) • Make and record monthly observations from a single prairie spot (60) • Compare biodiversity in a prairie and lawn (74) • Consider how organisms contribute to the prairie community (70)	• Collect seed from a restoration or remnant for the prairie (83)
Math			• Identify geometric shapes in prairie plants (35)	• Monarch Chrysalis and Butterfly: determine migration route and compute migration miles (52)		

Prairie Ecology and Restoration: Scope and Sequence

Level K-2	**Prairie Definition and Introduction**	**Human Habitation and Cultural History**	**Prairie Plants**	**Prairie Insects, Birds and Mammals**	**Ecosystem Interactions**	**Restoration**
Language Arts		• Read and listen to accounts from early settlers (18)	• Create an identification booklet with solar graphics (42) • Create poetry based on a single plant (105) • Learn first sounds and letters of prairie plant's name through movement game (34)	• Brainstorm how animals use the prairie (55) • Monarch Chrysalis and Butterfly: compose poetry, legends and creative stories (52) • Visualize and describe life as a prairie ant (46) • Consider how organisms contribute to the prairie community (70)	• Make and record monthly observations from a single prairie spot (60)	
Social Studies		• Read and listen to accounts from early settlers (18) • Make and use dyes from prairie plants (19) • Design a prairie celebration (16)		• Monarch Chrysalis and Butterfly: determine migration route, compute migration miles (52)		
Art/ Music		• Design a prairie celebration (16) • Make and use dyes from prairie plants (19)	• Variation of "Farmer in the Dell" to introduce prairie plants (36) • Create prairie grass crayon rubbings (31) • Create an identification booklet with solar graphics (42)	• Monarch Chrysalis and Butterfly: model life cycle stages (52) • Listen to "Flight of the Bumblebee" and create your own insect symphony (48)	• Make and record monthly observations from a single prairie spot (60)	

Prairie Ecology and Restoration: Scope and Sequence

Level 3-5	Prairie Definition and Introduction	Human Habitation and Cultural History	Prairie Plants	Prairie Insects, Birds and Mammals	Ecosystem Interactions	Restoration
Science	* Keep climatological data for your restoration site (13)	* Consider the connection between the U.S. agriculture and prairie soil (22) * Make and use dyes from prairie plants (19)	* Develop a prairie plant classification scheme (44) * Grow a prairie plant and observe, measure and graph growth (37) * Observe, measure and graph shoot and root growth (39) * Scavenger hunt for plant adaptations (43) * Design and model a hypothetical "best" seed (28) * Create an identification booklet with solar graphics (42) * Student groups research a prairie plant; share findings in creative format (30) * Hypothesize and test leaf orientation frequency in Compass Plant (45) * Familarize students with prairie plants through movement game (34)	* Brainstorm how animals use the prairie (55) * Monarch Chrysalis and Butterfly: observe (52) * Observe pollination and nectar collecting behavior (47, 54)	* Take a single-sense walk in the prairie (61) * Dissect and examine prairie soil (78) * Examine positive and negative interactions between prairie organisms (69) * Food Chain: Observe two-link, identify three-link (63) * Examine single prairie niches; fit them back together (67) * Compare biodiversity in a prairie and lawn (74) * Consider how organisms contribute to the prairie community (70)	* Research major prairie plant families (80) * Measure and compare air pollution at potential restoration sites (94) * Collect seed from a restoration or remnant for the prairie (83) * Develop signs and pamphlets describing the restoration project to the public (82) * Create a prairie mural with real seeds and drawings plant (96) * Experiment with site preparation methods and weed control (100) * Adopt-a-Species: Research, grow, transplant, tag and follow in restoration (107)
Math		* Calculate total prairie acreage consumed by large cities in the state (24)	* Identify geometric shapes in plants (35) * Measure and analyze prairie plant heights (38) * Grow a prairie plant and observe, measure and graph growth (37) * Observe, measure and graph shoot and root growth (39)	* Monarch Chrysalis and Butterfly: determine migration route, compute migration miles (52)		* Determine project price for various restoration plans (97) * Determine height of trees and buildings on restoration site (101) * Determine price for various restoration plans (97) * Word problems concerning number of seed, amount of seed, cost of seed, rank seeds by cost, etc. (95)

Prairie Ecology and Restoration: Scope and Sequence

Level 3-5	Prairie Definition and Introduction	Human Habitation and Cultural History	Prairie Plants	Prairie Insects, Birds and Mammals	Ecosystem Interactions	Restoration
Language Arts		* Read and listen to accounts from early settlers (18) * Create a fictional journal of a Native American or early prairie settler (18)	* Student groups research a prairie plant; share findings in creative format (30) * Write a poem, sonnet or Haiku for a plant (105) * Create an identification booklet with solar graphics (42) * Familarize students with prairie plants through movement game (34)	* Brainstorm how animals use the prairie (55) * Monarch Chrysalis and Butterfly: compose poetry, legends and creative stories (52) * Insect Pollination: write a dialogue between a plant and pollinator (54)	* Take a single-sense walk in the prairie (61)	* List changes necessary to save and enlarge prairie remnants (98) * Write a letter to a great grand-parent/ child explaining your restoration efforts (98) * Consider pros and cons of strategies for eliminating unwanted species (81) * Interview area residents about local history (85) * Prairie Newsletter: write pieces (110) * Develop signs and pamphlets describing the restoration project to the public (82) * Prairie poetry and journal (104)
Social Studies		* Read and listen to accounts from early settlers (18) * Find local town and landmark names which reflect a prairie heritage (24) * Calculate total prairie acreage consumed by cities in the state (24) * Consider the connection between the U.S. agriculture and prairie soil (22) * Make and use dyes from prairie plants (19) * Design a prairie celebration (16) * Create a fictional journal of a Native American or early prairie settler (18)		* Monarch Chrysalis and Butterfly: determine migration route and compute migration miles (52)		* Interview area residents about local history (85) * List changes necessary to save and enlarge prairie remnants (98) * Compare air pollution at restoration sites (94) * Consider pros and cons of strategies for eliminating unwanted species (81) * Develop signs and pamphlets describing the project to the public (82) * Study introduction of nonnative plants to the New World (93)
Art/ Music		* Make and use dyes from prairie plants (19) * Design a prairie celebration (16)	* Create an identification booklet with solar graphics (42) * Design and model a hypothetical "best" seed (28)	* Monarch Chrysalis and Butterfly: model life cycle stages (52) * Discover which instruments best mimic bird calls (57) * Listen to "Flight of the Bumblebee" and create your own insect symphony (48)		* Create a prairie visions poster (98) * Develop signs describing project to the public (82) * Create a prairie mural with real seeds and drawings plant (96)

Prairie Ecology and Restoration: Scope and Sequence

Level 6-8	Prairie Definition and Introduction	Human Habitation and Cultural History	Prairie Plants	Prairie Insects, Birds and Mammals	Ecosystem Interactions	Restoration
Science	• Keep climatological data for your restoration site (13) • Determine climatological factors necessary for prairie establishment (14) • Examine and calculate the grass to forb ratio in a prairie (12) • Calculate the percentage of "edge" in a prairie remnant (10)	• Consider the connection between the U.S. agriculture and prairie soil (22) • Compare prairie-based diets to your own (21) • Make and use dyes from prairie plants (19) • Global Grasslands: compare biology, history and treatment (17)	• Develop a prairie plant classification scheme (44) • Develop a simple species key (27) • Create an identification booklet with solar graphics (42) • Examine diversity of prairie plants (29) • Student groups research a prairie plant; share findings in creative format (30) • Plant Adaptations: observe and correlate (43) • Design and model a hypothetical "best" seed (28) • Grow a prairie plant and experiment with optimal growing conditions (37) • Observe and measure shoot and root growth (39) • Hypothesize and test leaf orientation frequency in Compass Plant (45) • Examine correlation between transpiration and environment (40) • Familarize students with prairie plants through movement game (34) • Correlate seed weight and total seed set (26)	• Compare plant and animal life cycles and their role in the community (56) • Observe insect and plant host relationships (53) • Insect Galls: survey frequency, host plant, height, size (51) • Observe pollination and nectar collecting behavior (47, 54) • Monarch Chrysalis and Butterfly: observe (52) • Survey butterfly populations (47)	• Test theories that explain savanna settlement trends (62) • Take a single-sense walk in the prairie (61) • Observe plant root's growth (72) • Observe and record phenology sequences including color, blossoming and insect life (65) • Determine a plant's blooming curve (58) • Examine interactions between prairie organisms (69) • Model a prairie food web (63) • Examine single prairie niches; fit them together (67) • Analyze soil characteristics (73) • Estimate natural organic addition to prairie soils (64) • Measure water holding capacities of various soils (75) • Consider effects of a prairie burn (68) • Estimate prairie biomass; compare ecosystems (59, 79) • Measure biodiversity in a prairie and lawn (76)	• Research major prairie plant families (80) • Adopt-a-Species: Research, grow, transplant, tag and follow in restoration (107) • Collect seed from a restoration or remnant for the prairie (83) • Measure degree of slope on restoration site (92) • Experiment with site preparation methods and weed control (100) • Develop signs and pamphlets describing the restoration project to the public (82)
Math	• Examine and calculate the grass to forb ratio in a prairie (12) • Calculate the percentage of "edge" in a prairie remnant (10)	• Calculate total prairie acreage consumed by large cities in the state (24) • Compare prairie-based diets to your own (21)	• Graph shoot and root growth (39) • Correlate and graph seed weight and total seed set (26)	• Monarch Chrysalis and Butterfly: compute migration miles (52) • Insect Galls: graph frequency of host plant, height and size (50)	• Determine a plant's blooming curve (58) • Graph phenological sequences (65) • Estimate biomass; compare to other ecosystems (59) • Estimate natural organic addition in prairie soils (64)	• Map proposed restoration site (90) • Measure degree of slope on restoration site (92) • Determine height of trees and buildings on restoration site (101) • Compare seeding rates based on number/area versus weight/area; examine own seeding plan (84) • Determine project price for various restoration plans (97) • Word problems concerning number of seed, amount of seed, cost of seed, rank seeds by cost, etc. (95)

Prairie Ecology and Restoration: Scope and Sequence

Level 6-8	**Prairie Definition and Introduction**	**Human Habitation and Cultural History**	**Prairie Plants**	**Prairie Insects, Birds and Mammals**	**Ecosystem Interactions**	**Restoration**
Language Arts		* Read and listen to accounts from early settlers (18) * Create a fictional journal from a Native American or early prairie settler (18) * Compare prairie-based diets to your own (21) * Global Grasslands: compare biology, history and treatment (17)	* Student groups research a prairie plant; share findings in creative format (30) * Create an identification booklet with solar graphics (42) * Write a poem, sonnet or Haiku for a plant (105) * Familarize students with prairie plants through movement game (34)	* Monarch Chrysalis and Butterfly: compose poetry, legends and creative stories (52) * Insect Pollination: write a dialogue between a plant and pollinator (54)	* Take a single-sense walk in the prairie (60) * Describe, from a plant's viewpoint, a prairie fire (67)	* Interview area residents about local history (85) * Write a letter to a grandparent/child describing your project (98) * List changes necessary to save and enlarge prairie remnants (98) * Research land ownership records of school site (86) * Examine original land survey records of school site (88) * Write about a seed's journey to the New World from its native home (93) * Consider pros and cons of strategies for eliminating species (81) * Newsletter: write articles, letters to editor, essays (110)
Social Studies		* Read and listen to accounts from early settlers (18) * Create a fictional journal of a Native American or early prairie settler (18) * Make dyes from prairie plants (19) * Research local agricultural and prairie land use (23) * Research local settlement and prairie land use (24) * Compare prairie-based diets to your own (21) * Design a prairie celebration (16) * Find local town and landmark names which reflect a prairie heritage (24) * Calculate total prairie acreage consumed by cities in the state (24) * Consider the connection between the U.S. agriculture and prairie soil (22) * Global Grasslands: compare biology and history (17)		* Monarch Chrysalis and Butterfly: determine migration route and compute migration miles (52)	* Test anthropological theories that explain savanna settlement trends (62) * Compare the rate of addition of organic matter to soil in a natural prairie and in an agricultural system (64)	* Interview area residents about local history (85) * List changes necessary for prairie remnant preservation (98) * Navigate a map course (89) * Map proposed restoration site (90) * Research land ownership records of school site (86) * Examine original land survey records of school site (88) * Study introduction of nonnative plants to New World (93) * Consider pros and cons of strategies for eliminating species (81)
Art/ Music		* Make dyes from prairie plants (19) * Design a prairie celebration (16)	* Develop a pictorial species key (27) * Create an identification booklet with solar graphics (42) * Design and model a hypothetical "best" seed (28)	* Monarch Chrysalis and Butterfly: model life cycle stages (52 * Which instruments best mimic bird calls (57) * Listen to "Flight of the Bumblebee" and create an insect symphony (48)		* Create a poster depicting past, present and future prairie visions (98) * Create slide show of restoration effort (99)

Prairie Ecology and Restoration: Scope and Sequence

Level 9-12	**Prairie Definition and Introduction**	**Human Habitation and Cultural History**	**Prairie Plants**	**Prairie Insects, Birds and Mammals**	**Ecosystem Interactions**	**Restoration**
Science	• Keep climatological data for your restoration site (13) • Determine climatological factors necessary to prairie establishment (14) • Examine the grass to forb ratio in a prairie (12) • Calculate the percentage of "edge" in a prairie remnant (10)	• Make and use dyes from prairie plants (19) • Compare prairie-based diets to your own (21) • Global Grasslands: compare biology, history and treatment (17) • Consider the connection between the U.S. agriculture and prairie soil (22)	• Examine diversity of prairie plants (29) • Student groups research a prairie plant, share findings in creative format (30) • Develop a prairie plant classification scheme (44) • Develop a simple species key (27) • Observe and correlate plant adaptations (43) • Observe and model a seed (32) • Grow a prairie plant and experiment with optimal growing conditions (37) • Produce a photoessay of an plant's life cycle (33) • Hypothesize and experiment with seed treatment and germination rates (41) • Correlate seed weight and total seed set (26) • Examine correlation between transpiration and environment (40)	• Observe pollination and nectar collecting behavior (47, 54) • Insect Pollination: examine aspects of nectar foraging strategies (49) • Observe insect and plant host relationships (53) • Insect Galls: survey frequency, host plant, height, size (50) • Survey butterfly populations (47)	• Test anthropological theories that explain savanna settlement trends (62) • Observe and record phenology sequences including color, blossoming, insect life, geometric shapes (65) • Examine interactions between prairie organisms (69) • Analyze soil profile, moisture, nutrients and organic matter concentration (73) • Measure water holding capacities of various soils (75) • Estimate prairie biomass; compare ecosystems (59, 79) • Estimate natural rate of organic addition in prairie soils (64) • Observe and consider effects of a prairie burn (68) • Measure, analyze and compare biodiversity in a prairie and lawn (76) • Determine a plant's blooming curve (58) • Examine single prairie niches; fit them together (67)	• Research major prairie plant families (80) • Collect seed from a restoration or remnant for their prairie (83) • Set up experiments testing site preparation methods and weed control (100) • Develop signs and pamphlets describing the restoration project to the public (82) • Measure degree of slope on restoration site (92) • Adopt-a-Species: Research, grow, transplant, tag and follow in restoration (107)
Math	• Calculate the percentage of "edge" in a prairie remnant (10) • Examine the grass to forb ratio in a prairie (12)	• Compare prairie-based diets to your own (21) • Calculate total prairie acreage consumed by large cities in the state (24)	• Correlate seed weight and total seed set (26)	• Insect Galls: survey frequency, host plant, height, size (50)	• Estimate natural rate of organic addition in prairie soils (64) • Estimate prairie biomass; compare to other ecosystems (59) • Determine a plant's blooming curve (58) • Graph phenological sequences (65)	• Map restoration site (90) • Determine height of trees on restoration site (101) • Create plant purchase plan based on project budget and desired seed list (97) • Measure slope on restoration site (92)

Level 9-12	**Prairie Definition and Introduction**	**Human Habitation and Cultural History**	**Prairie Plants**	**Prairie Insects, Birds and Mammals**	**Ecosystem Interactions**	**Restoration**
Language Arts		• Read and listen to accounts from early settlers (18) • Create a fictional journal from a Native American or early prairie settler (18) • Compare prairie-based diets to your own (21) • Global Grasslands: compare biology, history and treatment (17) • Consider the connection between the U.S. agriculture and prairie soil (22)	• Student groups research a prairie plant; share findings in creative format (30)		• Describe, from a plant's viewpoint, a prairie fire (68)	• Interview long-time area residents about local history (85) • Write a letter to a great grandparent/child explaining why you are restoring a prairie (98) • List changes necessary in order to save and enlarge prairie remnants (98) • Research land ownership records of school and restoration site (856 • Examine original land survey records of school and restoration site (88) • Write an essay about a seed's journey to the New World from its native home (93) • Consider pros and cons of strategies for eliminating unwanted species (81) • Develop signs and pamphlets describing the restoration project to the public (82) • Newsletter: write, layout and distribute (110) • Prairie poetry and journal (104)
Social Studies		• Read and listen to accounts from early settlers (18) • Create a fictional journal of a Native American or early prairie settler (18) • Make and use dyes from prairie plants (19) • Compare prairie-based diets to your own (21) • Examine local agricultural and prairie land use (23) • Research local settlement and prairie land use (24) • Design a prairie celebration (16) • Global Grasslands: compare biology, history and treatment (17) • Calculate total prairie acreage consumed by cities in the state (24)			• Test anthropological theories that explain savanna settlement trends (62) • Compare the rate of addition of organic matter to soil in a natural prairie and in an agricultural system (64)	• Interview long-time area residents about local history (85) • List changes necessary to save and enlarge prairie remnants (98) • Map restoration site (89) • Navigate a map course to learn mapping skills (89) • Research land ownership records of school and restoration site (86) • Examine original land survey records of school site (88) • Study introduction of nonnative plants to the New World (93) • Consider pros and cons of strategies for eliminating unwanted species (81) • Write a press release about the restoration project and send to local media (110) • Present experimental results in symposia, scientific articles and press releases (111) • Develop signs and pamphlets describing the restoration project to the public (82)
Art/ Music		• Make and use dyes from prairie plants (19) • Design a prairie celebration (16)	• Develop a pictorial key (27) • Produce a photoessay of a plant's life cycle (33)	• Listen to "Flight of the Bumblebee" and create an insect symphony (48)		• Create poster session to display experimental results (111) • Create a video or slide show to document restoration effort (92) • Develop signs and pamphlets describing the restoration project to the public (81) • Produce newsletter (110)

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NATIVE PLANT NURSERIES

The following companies and organizations may be able to provide you with seed or plants native to Wisconsin or the Midwest. Except as noted, seeds and plants are generally nursery grown. Some companies may also provide consulting, design, landscape installation, and/or maintenance services.

When doing any plantings to restore or re-create a natural area it is best to obtain seeds or plants from as close to your planting site as possible. Note: if a nursery cannot state that their plants are "nursery-propagated" then they may have been collected from the wild. Most nurseries should be willing to tell you the source of their plants. Ask to assure the source if you intend to purchase nursery-propagated plants or seed obtained from local sources.

This list was compiled by the Bureau of Endangered Resources, Wisconsin Department of Natural Resources (WDNR). This list does not imply any endorsement or recommendation by the WDNR. Revisions or additions to the list should be sent to BER, WDNR, P.O. Box 7921, Madison, WI 53707 (Attn: Kelly Kearns), or phone (608) 267-5066.

Applied Ecological Services, Inc./Taylor Creek Nursery, has prairie, woodland and wetland plants for use in restoration projects. They do ecological research and consulting, site preparation, planting, burning or other management. Contact: Steve Apfelbaum, Ron Wade or Gary Cole, Applied Ecological Services, Inc., Route 3, 17921 Smith Road, P.O. Box 256, Brodhead, WI 53520. 608-897-8547.

Arthur Lonegran Nursery sells deciduous trees and native perennials dug per order from their large woods. No mail order. Call or visit after 6pm. Contact: Arthur Lonegran, 3048 Paradise Drive, West Bend, WI 53095. 414-334-3812.

Biophilia specializes in butterfly gardening and native plants that attract butterflies. Contact: Randall Korb, 1903 N. Whitney Drive, Appleton, WI 54914.

Bluestem Farm consultation, plants and services primarily in Baraboo area, no mail order. Specialize in custom propagation of difficult species, including orchids. Contact: Martha Barrett and Scott Weber, Bluestem Farm, S5920 Lehman Rd., Baraboo, WI 53913. 608-356-0179.

Boehlke's Woodland Gardens can supply you with woodland ferns and perennials. Contact: Daniel Boehlke, 5890 Wausaukee Rd., West Bend, WI 53095, 414-675-2740.

Country Road Greenhouse is a wholesale grower specializing in containerized prairie and wetland forbs, grasses and sedges. Contact: County Road Greenhouse, 19561 E. Twombly, Rochelle, IL 61068. 815-384-3311.

Country Wetlands Nursery carries wide range of wetland plants and seeds from Wisconsin stock, as well as some prairie and woodland seeds. They specialize in wetland consultation, design and management for gardens and restorations. With sufficient lead time, they can provide seed or plants for larger projects. Contact: JoAnn Gillespie, Country Wetlands Nursery Ltd., Box 126, Muskego, WI 53150. 414-679-1268.

Donald L. Vorpahl Associates provides site evaluation and design, seed and plant selection, planting and management services for restoring and developing native plant communities on commercial and residential sites of all sizes. Contact: Don Vorpahl, N6143 Hilbert Rd., Hilbert, WI 54129. 414-853-3729.

Genesis Nursery carries seed for over 400 prairie, wetland, and savanna species and containerized plants for about 100 species. NW Illinois ecotypes. Also provides consultation, restoration, and planting. Contact: Dennis Lubbs, 23200 Hurd Road, Tampico, IL 61283. 815-438-2220, FAX 815-438-2222.

Great Lakes Nursery Co. offers approximately 70 species of seedlings and saplings of mostly native trees and shrubs, as well as tree planting supplies. Contact: Tim Gutsch, 1002 Hamilton St., Wausau, WI 54403. 715-845-7752.

Ion Exchange specializes in selling prairie, wetland and savanna seed and plants native to WI, Illinois, Iowa and the general driftless area. Contact: Howard and Donna Bright, 1878 Old Mission Drive, Harpers Ferry, IA 52146. 319-535-7231, FAX 319-535-7362.

Kettle Moraine Natural Landscaping carries seed of about 50 prairie species, does consulting and is available to work on restoration projects. Contact: c/o Connie Ramthun, W996 Birchwood Drive, Campbellsport, WI 53010. 414-533-8939.

Landscape Alternatives offers 150 species of prairie, wetland and woodland plants (no seeds). Catalog is $2.00. Contact: Roy Robinson, Landscape Alternatives, Inc., 1465 Pascal Street, St. Paul, MN 55108. 612-488-3142.

Little Valley Farm carries both seeds and plants of many native species of grasses, forbs, shrubs, trees and vines. Contact: Barbara Glass, Little Valley Farm, Route 3, Box 544, Snead Creek Road, Spring Green, WI 53588. 608-935-3324.

Midwest Wildflowers can supply you with over 100 species of wildflower seeds. Catalog $1.00. Contact Leroy Busker, Midwest Wildflowers, Box 64, Rockton, IL 60172.

Murn Environmental, Inc. carries a range of seed for wetland, woodland, and forest species. They also do restoration, design, planting, management and research. Contact: Tom Murn, Murn Environmental, Inc., 532 E. Milwaukee, St., Whitewater, WI 53190. 414-473-2737.

Nature's Nursery carries native prairie, wetland and woodland seeds and plants propagated from southern Wisconsin stock. They are also available for landscaping advice and slide presentations. Contact: Melody Moore, Nature's Nursery, 6125 Mathewson Road, Mazomanie, WI 53560. 608-795-4920.

Prairie Future Seed Co. can supply you with 110 species of plants and 230 species of seed of prairie and open woods species native to Wisconsin. They also do consulting and restoration projects. Contact: Randy R. Powers, Prairie Future Seed Co., P.O. Box 644, Menomonee Falls, WI 53052. 414-820-0221.

Prairie Moon Nursery carries seed and plants of over 200 native prairie, wetland and woodland plants derived from the W. Wisconsin/SE Minnesota/N. Illinois area. Contact: Alan Wade, Prairie Moon Nursery, Route 3, Box 163, Winona, MN 55987. 507-452-1362, 507-452-5231.

Prairie Nursery has both seeds and plants of many native prairie species as well as some wetland and woodland seeds and plants. They provide an array of consulting services, including: site evaluation, planting design, site preparation, planting and post-planting management for sites of all sizes. Contact: Neil Diboll, Prairie Nursery, P.O. Box 306, Westfield, WI 53964. 608-296-3679.

Prairie Restorations, Inc., specializes in restoration and maintenance of prairies. Retail sale of prairie plants is done mail order or at their nursery northwest of Minneapolis. Contact: Ron Bowen, Prairie Restorations, Inc., P.O. Box 327, Princeton, MN 55371. 612-389-4342 (office), 612-389-5733 (nursery).

Prairie Ridge Nursery/CRM Ecosystems, Inc., has prairie, wetland and woodland seeds and plants. They are also available for consulting, planning, planting and management services for projects of all sizes. Contact Joyce Powers, Prairie Ridge Nursery, RR2 9738 Overland Road, Mt. Horeb, WI 53572-2832. 608-437-5245.

Prairie Seed Source sells local SE Wisconsin seed of more than 150 prairie and savanna species, including mixes suited to the soil moisture regime of your project. They can also give slide presentations and provide consulting services. Contact: Robert Ahrenhoerster, Prairie Seed Source, P.O. Box 83, North Lake, WI 53064-0083. 414-673-7166.

Reeseville Ridge Nursery deals mainly with native trees and shrubs. Also specializes in custom propagation of woody plants. Contact: Darrell J. Kromm, Reeseville Ridge Nursery, P.O. Box 171, 309 South Main Street, Reeseville, WI 53579. 414-927-3291.

Retzer Nature Center, as a service of Waukesha County Parks, supplies native prairie, woodland and wetland plants and seeds for sites within 50 miles from the Waukesha County line. They specialize in prairie mixes and can provide technical assistance on restoration projects. Contact: Jerry Schwarzmeier, Retzer Nature Center, W284 S1530 Rd. DT, Waukesha, WI 53188. 414-521-5407.

Rohde's Nursery can supply you with woodland, wetland and prairie plants. They also provide a complete design service along with the ability to install/build any size project, as well as help with consultation and restoration. Contact: Lenn Rohde, N8098 Duck Creek Ave., Neshkoro, WI 54960. 414-293-4373.

Wehr Nature Center can provide persons in SE Wisconsin with prairie seeds and instructions for small scale prairie gardening. Contact: Wehr Nature Center, 9107 West College Avenue, Franklin, WI 53132. 414-425-8550.

Wisconsin Prairie Enthusiasts is a non-profit membership organization that sells a variety of prairie seeds and can collect specific species if contacted ahead of time. They can also provide consultation and management services, including prescribed burning. Members may become active in a wide range of prairie surveys, management, restoration and education projects. Contact: c/o Gary Eldred, 4192 Sleepy Hollow Trail, Boscobel, WI 54805. 608-375-5271.

Wildflower Terra is a native plant nursery also specializing in wildflower photography and slide presentations. Contact: Thomas F. Pelen, 3310 W. Scott St., Milwaukee, WI 53215. 414-645-1135.

The following companies sell plants native to the midwest, but not specifically from Wisconsin or the surrounding area. Many of these companies also sell non-native species. If your objective is to use only native species, use discretion in the species you select from these nurseries, or ask for plants which came from your region. Several of the following companies sell plants collected from the wild. This is indicated in the nursery description where known.

Bauer's Garden Center carries some woodland and prairie wildflowers and grasses as well as ornamentals. Contact them at: 1559 West Forest Home Ave., Milwaukee, WI 53204.

Brehm's Wonder Creek Nursery sells a number of native perennials as well as horticultural species. Contact them at: N6050 South Crystal Lake Rd., Beaver Dam, WI 53916. 414-885-4300.

Berthold Nursery has a variety of native trees and shrubs. Contact: Rick Repenning, Berthold Nursery, 4510 Dean Street, Woodstock, IL 60098. 815-338-4914, 708-439-2600.

Branch River Trout Hatchery specializes in nursery-grown submergent and floating aquatic plants, both native and non-native. They can also do design and planting of water gardens. Contact: Steve DeBaker, 8150 River Road, Greenleaf, WI 54126. 414-864-7761.

The Flower Factory has an extensive selection of native, non-native, and ornamental plants. Contact: David or Nancy Nedveck, 4062 Hwy. A, Stoughton, WI 53589. 608-873-8329.

Glen Flora Nursery sells nursery propagated perennials including prairie forbs and woodland shrubs and trees. Contact: Cathy or Jim Kollath, 8407 Glen Flora Rd., Kiel, WI 53042. 414-773-2493.

H & R Nursery, Inc. carries woodland wild flowers and ferns in addition to horticultural species. They do not sell seeds or mail order their plants. Contact: Dale Rickert, 6520 W. Silver Spring Dr., Milwaukee, WI 53218. 414-466-6289.

Illini Gardens deals with both prairie and woodland plants. Contact: Illini Gardens, P.O. Box 125, Oakfield, IL 62673.

Hauser's Superior View Farm has northern grown perennials and biennials, a few of which are species native to Wisconsin. They have a minimum order of $25.00. Contact: Jim Hauser, Route 1, Box 199, Bayfield, WI 54814. 715-779-5404.

J and J Tranzplant specializes in wild collected aquatic plants. Custom order and brochure available. Contact: Jim and Kris Malchow, P.O. Box 2532, Oshkosh, WI 54903-2532. 414-622-3552.

Johnson's Nursery Inc. are growers of a wide selection of balled and burlapped landscape plants. Among this diverse selection includes many native trees, shrubs, and vines. Contact: Bill Reichenbach, Johnson's Nursery, Inc., W180 N6275, Marcy Rd., Menomonee Falls, WI 53051. 414-252-4988.

Jung Seeds Co. has a brochure which pictures all the prairie grasses and wildflowers they carry. Most seed and plants sold without regard to genetic source. Contact: L. L. Olds Seed Co., P.O. Box 77990, Madison, WI 53707. 608-249-9291.

Kester's Wild Game Food Nurseries, Inc. carries native wetland species as well as non-native species for wildlife plantings. They carry both wild collected and nursery-grown stock. Contact: Dave and Patricia Kester, P.O. Box V, Omro, WI 54963. 414-685-2929.

Marshland Transplant Aquatic and Woodland Nursery sells plants and seeds of aquatic, woodland and prairie species. Some plants and seeds are wild collected. Contact: Tom Traxler, P. O. Box 1, Berlin, WI 54923 (414) 361-4200.

Midwest Aquatics specializes in wild collected native wetland and aquatic species and custom harvest of seeds. Some plants are wild dug. Contact: Douglas Nelson, Midwest Aquatics, Route 360-5, Wautoma, WI 54982. 414-787-3282.

Midwest Wildflowers can supply you with wildflower seed. Contact them at: Box 64, Rockton, IL 60172.

Milaeger's Gardens carries some prairie grasses and wildflowers in addition to ornamentals. They can send you a catalog for $1.00. Contact: Milaeger's Gardens, 4838 Douglas Avenue, Racine, WI 53402-2498. 414-639-2371.

The Natural Garden carries many varieties of native and non-native wetland, prairie and woodland plants and has landscape design and construction services available. Contact: The Natural Garden, 38W443 Highway 64, St. Charles, IL 60174. 708-584-0150.

Northwind Perennial Farm Contact: Roy Diblik, Box 95, Springfield, WI 53716. 414-248-8229.

Oasis Water Gardens sells aquatic plants and supplies for water gardens and aquariums. Contact: Jerry Ray, 2968 Pine Tree Rd., Oneida, WI 54155. 414-869-1085.

Orchid Gardens has wildflowers, ferns and shrubs indigenous to northern Minnesota. Catalog is available for fifty cents. There is a fee for consultation. Contact: c/o Carl A. Phillips, 2232 139th Avenue N.W., Andover, MN 55304.

Shady Acres Nursery, Inc. retails some native plants (including aquatics), herbs, perennials, vines and provides garden design service. Contact: Wayne Eslyn, Shady Acres Nursery, Inc., 5725 South Martin Road, New Berlin, WI 53146. 414-679-1610.

Smith Nursery Co. sells wholesale native and non-native shrubs, vines and trees in multiples of 5 and 10. Seed is also available. Extensive selection in catalog. Contact: Bill Smith, Smith Nursery Co., P.O. Box 515, Charles City, IA 50616. 515-228-3239.

Ursus Studios LTD specializes in nursery grown and propagated native and tropical aquatic submergent and bog plants. They also offer consulting, design and installation services, including backyard water gardening and supplies. Contact: Robert C. Ruppel, Ursus Studios Ltd, 2019 N. 10th St., Sheboygan, WI 53081. 414-459-9699.

Wildflowers from Nature's Way specializes in prairie wildflower and grass seed mixes all from Iowa source plants. They also sell some woodland wildflowers. Contact: Dorothy Baringer, RR 1, Box 62, Woodburn, IA 50275. 515-342-6246.

Wildlife Nursery specializes in wild collected wetland and non-native plants that attract wildlife. They also do consulting. Contact: John J. Lemberger, P.O. Box 2724, Oshkosh, WI 54901. 414-231-3780.

	Stock Available		Habitat Types			Other Services	
NURSERY	Seed	Plants	Prairie	Wetland	Woodland	Consultation	Landscape Installation
Applied Ecol. Services/Taylor Creek	X	X	X	X	X	X	X
A. Lonegram Nursery Co.		X			X		
Bauers Garden Center		X	X		X		
Berthold Nursery		X			X		
Biophilia		X	X			X	
Bluestem Farm		X	X	X		X	X
Boehlke's Woodland Gardens		X			X		
Branch River Trout Hatchery		X		X			
Brehms Wonder Creek Nursery		X			X		
Country Road Greenhouse		X	X	X			
Country Wetlands Nursery	X	X	X	X	X	X	X
Donald L. Vorpahl Associates	X	X				X	X
Flower Factory		X	X		X		
Genesis Nursery	X	X	X	X	X	X	X
Glen Flora Nursery		X	X		X		
Great Lakes Nursery Co.		X			X		
H & R Nursery, Inc.		X			X		
Hauser's Superior View Farm		X			X		
High Meadows Farms	X	X	X		X	X	X
Illini Gardens		X	X		X		
Ion Exchange	X	X	X	X	X	X	
J&J Tranzplant		X		X			
Johannsen Greenhouses			X				
Johnson's Nursery		X			X		
Jung Seed Co.	X	X	X		X		
Kesters Wild Game Food Nursery	X	X		X			
Kettle Moraine Natural Landscaping	X		X			X	X
Landscape Alternatives		X	X	X	X		
Little Valley Farm	X	X	X	X	X	X	X

BEST COPY AVAILABLE

NURSERY	Stock Available		Habitat Types			Other Services	
	Seed	Plants	Prairie	Wetland	Woodland	Consultation	Landscape Installation
Midwest Aquatics	X	X		X			
Midwest Wildflowers	X		X				
Mileager's Gardens		X	X		X		
Marshland Transplant Aquatic and Woodland Nursery	X	X	X	X	X		
Murn Environmental Inc.	X	X	X	X	X	X	X
The Natural Garden		X	X	X	X	X	X
Nature's Nursery	X	X	X	X	X	X	X
Oasis Water Gardens		X		X			
Orchid Gardens		X			X	X	
Prairie Future Seed Co.	X		X			X	X
Prairie Moon Nursery	X	X	X	X	X		
Prairie Nursery	X	X	X	X	X	X	X
Prairie Restorations, Inc.	X	X	X	X		X	X
Prairie Ridge Nursery/CRM Ecosystems, Inc.	X	X	X	X	X	X	X
Prairie Seed Source	X		X			X	X
Reeseville Ridge Nursery		X			X	X	
Retzer Nature Center	X	X	X	X	X	X	
Rohdes Nursery		X	X	X	X	X	X
Shady Acres Nursery, Inc.		X	X	X	X	X	X
Smith Nursery Co.	X	X			X		
Southwest Wisconsin Prairie Enthusiasts	X	X	X			X	X
Ursus Studios Ltd.		X		X		X	X
Wehr Nature Center	X		X			X	
Wildflowers From Nature's Way	X	X	X		X	X	X
Wildflower Terra		X	X		X		
Wildlife Nursery		X		X		X	

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PRAIRIE SEED COLLECTING DATES (MAY - SEPTEMBER)
compiled by
Wayne Pauly and Amanda Coyle
August 1977

Dane County Highway & Transportation Department
2302 Fish Hatchery Road, Madison, Wisconsin 53713

Plants are listed under the earliest date that seeds were ripe and collected in Dane County, using eight years of data.

Habitat code: D = dry; M = mesic; W = wet

Wet prairie - Has more water than rainfall with water running on from surrounding land. A flat and poorly drained area.
Mesic prairie - The water soaks in and there is no standing water. It has good internal drainage.
Dry prairie - It has less water than rainfall because the water runs off, often on thin soil, limestone ridges, or steep hillsides.

May 15 - 31

DM Pasque-flower
Anemone patens
DM Prairie Smoke
Geum triflorum
DM Pussy-toes, Field
Antennaria neglecta

June 1 - 15

DM Pussy-toes, Plantain-leaved
Antennaria plantaginifolia
DM Wood Betony/Lousewort
Pedicularis canadensis

June 16 - 30

DMW Alum-root
Heuchera Richardsonii
DM Blue-eyed Grass
Sisyrinchium campestre
D Columbine
Aquilegia canadensis
DMW Cynthia, Two-flowered
Krigia biflora
M Geranium, Wild
Geranium maculatum
MW Indian Paintbrush
Castilleja coccinea
DM Lupine, Wild
Lupinus perennis
DM Needle Grass
Stipa spartea
M Ragwort, Balsam
Senecio pauperculus
MW Saxifrage, Swamp
Saxifraga pensylvanica

July 1 - 15

W Angelica
Angelica atropurpurea
D Frostweed, Bicknell
Helianthemum bicknellii
MW Garlic, Wild
Allium canadense
MW Hyacinth, Wild
Camassia scilloides
D New Jersey Tea, Early
Ceanothus ovatus
DM Pimpernel, Yellow
Taenidia integerrima
DMW Shooting Star
Dodecatheon meadia
DMW Spiderwort
Tradescantia ohiensis
DMW Toadflax, Bastard
Comandra richardsiana
M Vetch
Vicia angustifolia

July 16 - 31

D Frostweed
Helianthemum canadense
DMW Phlox, Downy
Phlox pilosa
DM Wood Mint, Downy
Blephilia ciliata

COLLECT SEEDS - NOT PLANTS

August 1 - 15

MW Anemone, Canada
Anemone canadensis

D Beard-tongue, Large flowered
Penstemon grandiflorus

MW Bedstraw, Northern
Galium boreale

DMW Black-eyed Susan
Rudbeckia hirta

DMW Coneflower, Yellow
Ratibida pinnata

MW Golden Alexanders/Meadow Parsnip
Zizea aptera

D Hawkweed, Long-haired
Hieracium longipilum

MW Hemlock, Water
Cicuta maculata

DM Lead-plant
Amorpha canescens

MW Meadow-rue, Purple
Thalictrum dasycarpum

M Oxeye, Yellow/Early Sunflower
Heliopsis helianthoides

D Prickly Pear Cactus
Opuntia compressa

D Puccoon
Lithospermum caroliniense

DM Puccoon, Hoary
Lithospermum canescens

DM Tick Trefoil, Illinois
Desmodium illinoense

DMW Vetchling/Veiny pea
Lathyrus venosus

MW Yarrow
Achillea millefolium

August 16 - 31

DMW Bergamot, Wild/Beebalm
Monarda fistulosa

DM Cinquefoil, Tall
Potentilla arguta

MW Cord Grass
Spartina pectinata

DM Dropseed, Prairie
Sporobolus heterolepis

D Grama Grass, Hairy/Mustache Grass
Bouteloua hirsuta

DMW Indigo, White Wild
Baptisia leucantha

DM Little Bluestem
Andropogon scoparius

M Onion, Nodding Wild
Allium cernuum

DM Prairie Clover, Purple
Petalostemum purpureum

DM Prairie Clover, White
Petalostemum candidum

August 16 - 31 (cont.)

DM Primrose, Evening
Oenothera biennis

DM Quinine, Wild
Parthenium integrifolium

DM Solomon's Seal, Great
Polygonatum canaliculatum

DMW Switchgrass
Panicum virgatum

DM Thimbleweed
Anemone virginiana

September 1 - 15

W Boneset
Eupatorium perfoliatum

DM Boneset, False
Kuhnia eupatorioides

DM Bush Clover, Roundheaded
Lespedeza capitata

DM Compass-plant
Silphium laciniatum

DM Coneflower, Purple
Echinacea pallida

MW Cup-plant
Silphium perfoliatum

MW Gayfeather, Prairie
Liatris pycnostachya

DM Goatsrue
Tephrosia virginiana

D Hyssop, Blue Giant
Agastache foeniculum

DM Indigo, Creamy Wild
Baptisia leucophaea

W Joe-Pye Weed
Eupatorium maculatum

M Lettuce, Wild
Lactuca canadensis

W Mallow, Glade
Napaea dioica

DMW Milkweed, Common
Asclepias syriaca

DMW Mountain Mint
Pycnanthemum virginianum

DM New Jersey Tea
Ceanothus americanus

DM Parsley, Prairie
Polytaenia nuttallii

D Partridge Pea
Cassia fasciculata

M Penstemon, Smooth/Beard-tongu
Penstemon digitalis

DMW Rosin-weed
Silphium integrifolium

D Side Oats Grama
Bouteloua curtipendula

M Sunflower, Woodland
Helianthus strumosus

DM Wild Rye, Canada
Elymus canadensis

September 16 - 30

DM	Aster, Upland White Aster ptarmicoides
DMW	Big Bluestem Andropogon gerardi
D	Blazing Star, Cylindric Liatris cylindracea
DM	Blazing Star, Rough Liatris aspera
DM	Butterfly-weed Asclepias tuberosa
DM	Coreopsis/Tickseed Coreopsis palmata
MW	Culver's Root Veronicastrum virginicum
MW	Gentian, Bottle Gentiana andrewsii
DM	Ground Cherry, Lance-leaved Physalis virginiana
DM	Hemp, Indian Apocynum cannabinum
MW	Hog Peanut Amphicarpa bracteata
D	Horse Mint Monarda punctata
DM	Indian Grass Sorghastrum nutans
MW	Indian-plantain, Pale Cacalia atriplicifolia
MW	Ironweed, Western Vernonia fasciculata

September 16 - 30 (cont.)

W	Lobelia, Great Blue Lobelia siphilitica
W	Milkweed, Swamp Asclepias, incarnata
M	Phlox, Smooth Phlox glaberrima
MW	Prairie-dock Silphium terebinthinaceum
D	Primrose, Sand Oenothera rhombipetala
DM	Rattlesnake-master Eryngium yuccifolium
DM	Rose, Prairie Rosa carolina
DMW	Sedge Carex bicknellii
MW	Sunflower, Big-toothed Helianthus grosseserratus
DM	Sunflower, Naked-stem Helianthus occidentalis
DM	Thimbleweed, Long-headed Anemone cylindrica
DM	Thistle, Old Field Cirsium discolor
MW	Tick Trefoil, Canada Desmodium canadense
W	Turk's-cap Lily Lilium superbum

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PRAIRIE SEED COLLECTING HINTS

Purpose: Collect seeds and <u>not plants</u>. Only collect plants when you are sure that an area will be destroyed. A plant in a remnant prairie may be five to 500 years old and many do not survive transplanting. But left undisturbed, a plant is a continuing source of seeds for you.

1. <u>Where</u>
   a. Many collecting areas exist along railroad and highway right-of-ways. Look for prairie remnants along "country roads," on steep hillsides, in marshes, and in poor farm country. Be sure to get permission before collecting on private property.
   b. Do not collect on:
      Arboretum or University properties
      Scientific areas
      Interstate highway right-of-way

2. <u>How to know when seeds are ripe</u>
   a. When seeds fall easily from the plant.
   b. When pods lose green color and turn brown.
   c. When stem feeding seed head is brown and dry.
   d. When seed capsule starts to open.
   e. Seeds are often ripe about one month after flowering.
   f. Ripe seeds are plump, hard, and usually brown or black; unripe seeds are usually soft and green.

Prairie Seed Collecting Hints, continued

3. Materials
   a. Paper bags (not plastic bags which retain moisture and may cause seeds to rot).
   b. Work gloves.
   c. Marking pencil.
   d. Clippers to cut off seed heads.
   e. Protective eye glasses (sun glasses, etc. to keep from poking yourself with grass stalks).

4. Procedure
   a. Collect on a dry day when seeds are not wet with dew or rain.
   b. Never take more than 50% of the seeds in an area. Leave some for the land.
   c. Label your seed bags with (1) date; (2) location; (3) name of plant; (4) type of site (dry, mesic, wet, sandy, loamy, rocky, etc.).
   d. If seeds are wet or excessively moist, spread them on newspaper to dry. Drying helps prevent the seeds from molding during storage.

5. Storage
   a. Put bags of seeds in burlap sacks or plastic garbage bags and hang them in an unheated garage or shed. If you use plastic bags, be sure that the seeds are dry, that the bags are packed loosely for good air circulation, and that holes are punched in the plastic. If seeds are stored on the floor you may have trouble with condensation and rodents. Prairie seeds must be stored in a cold place because they need that cold treatment for germination. A heated area can dry out seeds and kill them.
   b. Control insects in seeds by adding something like Shell no-pest strip.

* * * * * * * *

REFERENCES

Prairie Primer by Stan Nichols and Lynn Entyne. A good handbook containing drawings of prairie plants, information on where they grow, how to start a prairie, and much more good information. Available from Agricultural Bulletin Building, 1535 Observatory Drive, Madison, WI 53706. Publication No. G2736.

Prairie Propagation Handbook by Harold Rock. 1971. A good reference book for planting prairies. It has information about propagation, habitat, time to collect, etc. for a large number of prairie plants. Available from Wehr Nature Center, 5879 S. 92nd Street, Hales Corners, WI 53130.

Guide to the Arboretum Prairies by Binda Reich. 1971. An excellent introduction to the plants, animals, history, and ecology of prairies. Available from the University of Wisconsin Arboretum, 1207 Seminole Highway, Madison, WI 53711.

Vegetation of Wisconsin by John T. Curtis. 1959. A very readable text for the history and description of Wisconsin Prairies. Available from any major bookstore.

COMMON INVASIVE WEEDS OF PRAIRIE PLANTINGS

These weed charts are adapted from General Notes on planning and phasing in a broadcast seeded prairie establishment on a school site by Cathy Bruner, 1982. (unpublished)
For more information on specific controls for specific weeds, contact the Wisconsin Department of Natural Resources for the Exotic Species Control Manual.

Herbaceous Invaders of prairies.

Common invaders in large numbers, but persist only under disturbance. Handled by proper **site preparation and mowing** of site after planting at 6-8" when weeds are in flower or getting more than 6" tall.

Abutilon theophrasti	velvetleaf
Amaranthus retroflexus	pigweed
Ambrosia artemesifolia	common ragweed
Ambrosia trifida	giant ragweed
Berteroa incana	hoary alyssum
Brassica nigra	black mustard
Capsella bursa-pastoris	shepherd's purse
Chenopodium album	lambsquarters
Conyza canadensis	horseweed
Euphorbia maculata	spotted spurge
Lepidium virginicum	common peppergrass
Rumex crispus	curly dock
Tragopogon major	goatsbeard

grasses	
Alopecurus carolinianus	annual foxtail
Digitaria sanguinalis	hairy crabgrass
Panicum capillare	witchgrass

Persistent invaders, sometimes unfavorably competitive.
If present on your site **remove prior to planting.**

Agrostis alba	redtop grass
Bromus sp. (Eurasian)	brome grass
Cichorium intybus	chicory
Cirsium vulgare	bull thistle
Echinochloa crusgalli	barnyard grass
Medicago sp.	alfalfa and black medic
Poa sp.	Kentucky and Canada bluegrass
Taraxacum officinale	dandelion

Persistent invaders, unfavorably competitive with new or existent prairie stands. These plants smother out other plants by cover and perhaps chemical relationships (allelopathic). **Remove prior to planting and continually monitor planting for their presence.**

Agropyron repens	quackgrass
Arctium minus	burdock
Carduis acanthoides	welted thistle
Cirsium arvense	canada thistle
Convolvulus sp.	bindweeds
Daucus carota	Queen Anne's lace
Euphorbia esula	leafy spurge
Melilotus spp.	yellow and white sweet clover
Pastinaca sativa	wild parsnip
Phalaris arundinacea	reed canary grass
Sanchus arvensis	sow thistle
Trifolium pretense	red clover

Removal techniques vary with the extent of the problem. Site preparation techniques are covered elsewhere, but basically include multiple tillage; mulch for a period long enough to kill existing weeds; or herbicides. After planting removal of few individuals may be accomplished by weeding or digging.

CHILDREN'S LITERATURE

The following books were selected, in most cases, because of their relevance to things related specifically to prairie ecology, natural and cultural history. There are many other fine books for children that focus on aspects of environmental study and awareness. A useful reference for locating these books is *E for Environment: An Annotated Bibliography of Children's Books with Environmental Themes* by Patti K. Sinclair (Bowker, 1992).

Sinclair's book contains lengthy annotated bibliographical references with notes as to appropriate age level (where ages are indicated for books on the following list, we are indebted to Sinclair's book). The book is divided into five main chapters. In Planting the Seeds of Environmental Awareness: Introducing Young Children to Nature, she includes subchapters on "A Sense of Wonder", "Enjoying Nature with Family and Friends", and "Respect for All Living Things". The Web of Life has subchapters on general ecology and various ecosystems, including not only forests, deserts, mountains, grasslands, wetlands, oceans, etc., but also urban and other unique habitats. In At Issue, there are references on topics of current interest--endangered species, pollution, garbage and recycling, animal rights, energy, population and food supply, and climate. People and Nature focuses on the relationship of people to the land, with subchapters such as "Our Earth, Our Home", "The Changing Landscape", and "People Make a Difference"; several excellent collections of legends from Native American cultures are included here. Finally, in It's Your Turn: Activities, Explorations, and Activism, she lists books under four topic areas: "Discovering", "Exploring", "Tending the Earth", and "Taking Action".

NOTE: Some books on this list are set in meadows. There is no standard definition of what constitutes a meadow and the use of the term is somewhat imprecise (it is sometimes even used interchangeably with "prairie"). The term is not an ecological one and does not describe an ecological community (of which prairie is an example), where specific plants and animals have evolved together over centuries. Thus, there is no scientifically-agreed-upon list of meadow plants.

Like a prairie, a meadow is an open, sunny grassland. Typically, it has a mix of grasses and flowers that grow up to about knee-height. It is often a disturbed site, and usually has both native and non-native plants. Many prairie plants are found in meadows and animals typical of prairies (foxes, butterflies, various birds, and mice) frequent meadows.

Because there are important parallels between meadows and prairies, and descriptions of experiences in meadows are often similar to those in prairies, meadow stories have been included in this prairie bibliography.

Awareness, Celebration, Enjoying and Sharing Nature

Carlstrom, Nancy White. *Wild, wild sunflower child Anna*. Macmillan, 1991. Fiction, ages 3-7.

Anna, a young black girl, experiences a joyful early summer day in a flower-filled meadow picking berries, digging in the garden, going barefoot across a creek, climbing a tree, watching insects.

Cooney, Barbara. *Miss Rumphius*. Viking, 1982. Fiction, ages 4-8.

A young woman travels around the world, then returns home and spends the rest of her life planting native lupines across the countryside. An inspiring story showing how one person can make a difference and take responsibility for making the world a more beautiful place.

a difference and take responsibility for making the world a more beautiful place.

Ehlert, Lois. *Feathers for lunch*. Harcourt, 1990. Fiction, ages 3-8.
Uses the antics of a cat looking for lunch to introduce children to bird watching; includes a mini-field guide.

Hamerstrom, Frances. *Walk when the moon is full*. Crossing, 1975. Nonfiction, ages 7-11.
Biologist Hamerstrom devised these thirteen moonlit walks, one for each full moon of the year, to help her two children explore the land around their Wisconsin farm. Includes the mating dance of the woodcock in April, swimming with frogs in the pond in August, and watching weasels play on a frozen marsh in December. Encourages walks to listen, watch, and smell.

Hines, Anna Grossnickle. *Come to the meadow*. Clarion, 1984. Fiction, ages 3-6.
Mattie shares her special place--a nearby meadow, filled with spring buttercups, shooting stars, a hop toad, turtle, field mice, and birds' eggs--with her family.

Martin, Bill, Jr., and Archambault, John. *Listen to the rain*. Holt, 1988. Fiction, ages 3-8.
Focuses on the sounds of nature through poetry; hear the rain as it whispers, sings, roars, pours, pounds and finally stops.

Ryder, Joanne. *Inside turtle's shell: And other poems of the field*. Macmillan, 1985.Nonfiction, age 6-10.
Free-verse poems incorporate life cycles through the seasons and meadow ecology as the activities of meadow animals (frog, fox, turtle, etc.) are described from their point of view.

Biography

Lorbiecki. *Of things natural, wild, and free: A story about Aldo Leopold*. Carolrhoda Books, 1993.
Published after Sinclair's bibliography was published. See Sinclair for other biographies of environmentalists, including Leopold, Muir and Carson.

Sufrin, Mark. *George Catlin: painter of the Indian West*. Atheneum, 1991.
Portrait painter of Plains Indians people and activities whose work became the "Indian" image of European-American culture.

Coloring Books

Kennedy, Paul E. *American wild flowers*. Dover, 1971.

Peterson, Roger Tory. *A field guide to wildflowers coloring book*. Houghton Mifflin, 1982.

Field Guides, Keys

Dana, Mrs. Williams Star. *How to know wildflowers*. Houghton Mifflin, 1989 (reprinted from 1893 edition).

Gold Junior Guides. Western Publishing Co.

Eight 8" x 8" hard-cover volumes developed for children.

Series includes: bees, wasps and ants; butterflies and moths; cardinals, robins and other birds; eagles, hawks and owls; sharks, rays and eels; snakes and lizards; starfish, seashells and eels; turtles, toads and frogs.

Golden Nature Guides. Western Publishing Co.

For all ages; excellent information for identification, classification and connection of various species.

Watts, May Theilgaard. *Nature study guild keys*. Nature Study Guild, originally published in 1963, variously revised.

Pocket-sized, easy-to-use guides for quick reference. Includes tree finder, fern finder, flower finder, winter tree finder.

Peterson First Guides. Houghton Mifflin.

For beginners -- adults and children alike -- who would like a simpler field guide than the standard ones. Like the guides in the Peterson Field Guide series, these small books utilize the "Peterson System", a visual system based on patternistic drawings with key field marks noted. Guides cover a selection of plants and animals most likely to be seen on initial forays in the field. Series includes guides on birds, clouds and weather, fishes, insects, mammals, reptiles and amphibians, the solar system, trees and wildflowers. A particularly charming and useful guide is *Caterpillars*, by Amy Bartlett Wright, 1993, which shows the caterpillars of common butterflies and moths, along with their adult forms.

Native Americans

Bruchac, Joseph, and London, Jonathan. *Thirteen moons on turtle's back: a Native American year of moons*. Philomel, 1992.

Collection of poems based on Native legend which give voice to the thirteen moons of the year and reveal the wonder of the seasons. Spectacular oil paintings by Thomas Locker.

Connolly, James E., ed. *Why the possum's tail is bare: and other North American Indian nature tales*. Stemmer, 1985. Fiction, ages 8 and up.

Good introduction, background on Native American traditions and relationships with nature.

DePaola, Tomie. *The Legend of the Indian Paintbrush*. Putnam & Grosset, 1988.

Little Gopher follows his destiny, as revealed in a Dream-Vision, of becoming an artist for his people and eventually is able to bring the colors of the sunset down to the earth.

Goble, Paul. *Iktomi and the boulder: a Plains Indian story*. Orchard Books, 1988. Legends.

Iktomi, a Plains Indian trickster, attempts to defeat a boulder with the assistance of some bats, in this story which explains why the Great Plains are covered with small stones.

Goble, Paul. *Iktomi and the buffalo skull: a Plains Indian story*. Orchard Books, 1990. Legends.

Iktomi, the Plains Indian trickster, interrupts a powwow of the Mouse People and gets his head stuck in a buffalo skull. Asides and questions printed in italics may be addressed by the storyteller to listeners, encouraging them to make their own remarks about the action.

Goble, Paul. *Iktomi and the buzzard: a Plains Indian story*. Orchard Books, 1994. Legends.

Iktomi, the trickster, tries to fool a buzzard into carrying him across the river on the buzzard's back. Asides printed in italics may be used by the storyteller to encourage listeners to make their own remarks about the action, as in traditional Iktomi storytelling.

Goble, Paul. *Iktomi and the ducks: a Plains Indian story*. Orchard Books, 1990. Legends.

After outwitting some ducks, Iktomi, the Indian trickster, is outwitted by Coyote.

Mayo, Gretchen Will. *Earthmaker's tales: North American Indian stories about earth happenings*. Walker, 1989. Fiction, ages 9-13.

A collection of North American Indian legends about the origins of floods, tornados, thunder, and other weather phenomena.

MacDonald, Fiona. *Plains Indians*. Quarto Publishing, 1992. Nonfiction.

Facts about the 32 different groups of Plains Indians and their life before and after the arrival of the Europeans.

Matthaei, Gay, and Grutman, Jewel. *The Ledgerbook of Thomas Blue Eagle*. Thomasson-Grant, 1994. Fiction.

Introduction to pictographs of the Plains Indians through an account of a young Sioux warrior, his childhood on the Plains, his journey East and his adventures at the Carlisle Indian School.

Frontier and Pioneer Life

Brink, Carol Ryrie. *Caddie Woodlawn*. Macmillan, 1973. Fiction.

Stories of the author's grandmother's pioneer childhood in Wisconsin in the 1860s.

Conrad, Pam. *Prairie songs*. Harper and Row, 1985. Fiction.

Life on a Nebraska prairie.

Conrad, Pam. *Prairie visions: The life and times of Solomon Butcher*. Harper Collins, 1991. Biography, nonfiction.

Solomon Butcher travelled in turn-of-the-century Custer County, Nebraska, recording the lives of the pioneers by setting their tales down on paper and their images in photographs. Compelling, well-done. Includes good bibliography.

Harvey, Brett. *My prairie year: Based on the diary of Eleanore Plaisted.* Holiday, 1986. Nonfiction.

Captures the reminiscences of the author's grandmother, who moved from Maine to the Dakota Territory in 1889. Vivid descriptions of the prairie at different times and moods -- in spring with gentle wildflowers, as an ocean of grass, with a violent storm that produces a tornado, and consumed by a raging prairie wildfire.

Holling, Holling C. *Tree in the trail.* Houghton Mifflin, 1970 (republished from 1941 edition). Fiction.

A cottonwood tree's history on the Santa Fe Trail, beginning as a sapling in 1610 to 1834, when it became a yoke for oxen. Illustrations make each time period come alive.

Lawlor, Laurie. *Addie across the prairie.* Whitman, 1986. Fiction.

Dakota homesteading stories based on research by the author at the South Dakota farm of her great-grandparents. This book is about Addie's first months as a Dakota pioneer. Other books in the series are: *Addie's Dakota Winter*, *Addie's Long Summer*, and *George on His Own*.

MacLachlan, Patricia. *Sarah, plain and tall.* Harper, 1986. Fiction.

Winner of the 1986 Newberry Medal. Curriculum guide available.

Wilder, Laura Ingalls. *Little house on the prairie.* Harper, 1953. Biography.

Stories of the author's childhood; born in 1867 in Wisconsin, she travelled through Kansas, Minnesota and the Dakota Territory in the 1870s and 80s. Other books in this series about pioneer life in the prairie states are: *Farmer Boy*, *On the Banks of Plum Creek*, *By the Shores of Silver Lake*, *The Long Winter*, *Little Town on the Prairie*, and *These Happy Golden Years*.

Environmental Issues and Problems

Earth Works Group. *50 simple things kids can do to save the earth.* Universal Press Syndicate Company, 1990.

Explains how specific things in a child's environment are connected to the rest of the world, how using them affects the planet, and how the individual can develop habits and projects that are environmentally sound.

Herda, D.J. *Environmental America: The north central states.* Millbrook, 1991 (Series: The American Scene). Nonfiction, ages 10-14.

Focuses on the ecology and environmental problems of the region, starting with the development of agriculture on the prairies and the effects of agricultural practices on the land. Includes suggestions for action, lists of organizations to contact, a glossary, colored photographs, maps and charts. Five other books in the series cover other regions of the country.

Pringle, Laurence. *What shall we do with the land? Choices for America.* Harper, 1981. Nonfiction, ages 11 and up.

Land practices in North America, including farmlands. Discusses the conflicts between uses dictated by needs and the need to love, respect and protect the land so that it will remain healthy.

Prairie Ecology, Natural History

Amsel, Sheri. *Grasslands*. 1992. Raintree/Steck, 1993. Nonfiction
Habitats of the world.

Berman, Ruth. *American Bison*. Carolrhoda Books, 1992. Nonfiction.
Describes in detail the life cycle of the bison and its role in the lives of both Native Americans and settlers. Full-color photographs.

Collinson, Alan S. *Grasslands*. Dillon, 1992. Nonfiction. Examines grasslands around the world and the life they support and discusses how they are surviving changes brought about by people and climate.

Costello, David Francis. *The prairie world*. University of Minnesota Press, 1980, c1969. Nonfiction.
Great Plains prairie ecology and natural history.

Curry-Lindahl, Kai. *Wildlife of the prairies and plains*. H. N. Abrams, 1981. Nonfiction.
Prairie and grassland ecology.

Cushman, Ruth Carol. *The shortgrass prairie*. Pruett Pub., 1988.
Prairie ecology.

Dvorak, Jr., David. *A sea of grass: the tallgrass prairie*. Macmillan, 1994.
Introduces the prairie's plants, animals,. insects, and weather. Full-color photographs. Includes a list of tallgrass prairie preserves and restorations.

Evans, Terry. *Prairie: images of ground and sky*. Nonfiction. University Press of Kansas, 1986.
Prairie ecology.

George, Jean Craighead. *One day in the prairie*. Harper, 1986. Nonfiction, ages 9-12.
Life in a southwestern Oklahoma prairie (including the activities of tarantulas, buffalo, elk and coyote) is described as a boy spends hours trying to photograph a prairie dog doing a backflip. A storm brews throughout the day and the boy, oblivious to it, narrowly escapes being swept away by a tornado.

Hess, Lilo. *Secrets in the Meadow*. Macmillan, 1986. Nonfiction, ages 10 and up.
Covers meadow ecology and nocturnal and daytime animals common to a meadow. Includes life cycles, adaptations, and behavior.

Hirschi, Ron. *Save our prairies and grasslands*. Delacorte Press, 1994. Nonfiction.
For elementary and middle school. Uses an historical perspective to discusses the three major prairies -- shortgrass, mixed grass and tall grass --, stating that we have drastically affected these communities, mostly through habitat loss. Solutions include becoming environmental advocates through writing letters to appropriate officials and prairie restoration at the schools.

Hirschi, Ron. *Who lives on...the prairie?* Putnam, 1989 (Series: Where Animals Live). Nonfiction, ages 3-8.

Text and colored photos introduce the sights and sounds of life on North American prairies, including the prairie dog, dancing birds, and long-tailed weasel. An attractive, basic introduction for younger children.

Lambert, David. *Grasslands*. Silver Burdett, 1988 (Series: Our World). Nonfiction, ages 10 and up.

Covers grasslands around the world, using color photographs in a large-size format. Includes human use and misuse of grasslands over time and methods for their conservation.

Lerner, Carol. *Seasons of the tallgrass prairie*. Morrow, 1980. Nonfiction, ages 9-12.

Prairie ecology, with a focus on plants. Includes the role of fire in preserving the prairie. Describes typical tallgrass plants of each season, their features and adaptations. Good detailed line drawings showing cutaways of plants, including extensive root systems. Useful in conjunction with field study using a field guide.

Market Communications, Inc. *Prairie animals*. Encyclopaedia Britannica, 1979. Nonfiction.

Describes the habits and characteristics of eight animals of the open prairie of central North America: the pronghorn, prairie dog, jackrabbit, meadowlark, bison, rattlesnake, coyote, and prairie chicken.

May, Julian. *The prairie has an endless sky*. Creative Educational Society, 1972. Nonfiction.

Describes the geography, wildlife and vegetation of the Great Plains of North America and discusses man's influence on this area.

Milne, Lorus J., and Milne, Margery. *A Shovelful of Earth*. Henry Holt, 1987. (out of print)

Soil of North American forests compared to those of deserts, grasslands, tundras, and rain forests, explaining how more exotic animals have adapted to their less hospitable environments.

Rowan, James P. *Prairies and grasslands*. Childrens, 1983 (Series: New True). Nonfiction, ages 7-10.

Simple introduction to prairies and grassland ecosystems, including how people have lived on and affected prairies. Oversimplification causes some inaccuracies.

Ryder, Joanne. *Where butterflies grow*. Dutton, 1989. Nonfiction, ages 5-7.

Encourages readers to imagine what it is like to be a swallowtail butterfly; covers habitat and the life cycle from egg to caterpillar to butterfly.

Schwartz, David M. *The hidden life of the meadow*. Crown, 1988. Nonfiction, ages 6-12.

A photo essay on the life in a meadow community through the seasons. Good introduction using captioned close-up photographs; informs while encouraging appreciation.

Selsam, Millicent and Goor, Ronald. *Backyard insects*. Scholastic, 1988. Nonfiction, ages 3-8.

Looks at common insects, including caterpillars, spittlebugs, bees, beetles, and butterflies, and how they protect themselves through camouflage, warning colors, and copycat coloration.

Selsam, Millicent and Hunt, Joyce. *Keep looking!* Macmillan, 1989. Nonfiction, ages 3-7.

A picture book of winter creatures and their habitats, including both active and hibernating

animals above and below ground.

Staub, Frank. *America's prairies*. Carolrhoda Books, 1994. Nonfiction.

How the prairie has played an important role in American history and how human settlement has changed the lives of prairie creatures. Full-color photographs.

Stone, Lynn M. *Prairies*. Rourke, 1989 (Series: Ecozones). Nonfiction, ages 9-12.

Describes tallgrass, mixed grass and short grass prairies, how they were formed and the plants and animals found there. Discusses how settlement and agriculture have destroyed much of the prairie community. Includes a list of prairie sites in the US and Canada and a list of activities for middle- and upper-grade students.

Restoration

Pringle, Laurence. *Restoring our earth*. Enslow, 1987. Nonfiction, ages 12 and up.

Focuses on solutions to environmental problems via the relatively new scientific field of ecological restoration. Encourages volunteering in restoration efforts. Includes efforts to restore damages grasslands on public and private land, with information about the historic work at the University of Wisconsin-Madison Arboretum.

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PRAIRIE RESTORATION BIBLIOGRAPHY

PRAIRIES

Ecology, Natural History

Allen, Durward L. *The life of prairies and plains*. McGraw-Hill, 1967.
Good basic introduction for the non-scientist.

Busch, Phyllis S. *Wildflowers and the stories behind their names*. Charles Scribner's Sons, 1977.
Picture book with brief vignettes of 50 wildflowers, explaining the probable origins of the common names and other background.

Costello, David F. 1969. *The prairie world*. Crowell, 1969.
Readable narrative about the biology of North American prairies and grasslands.

Curtis, John. *Vegetation of Wisconsin: An ordination of plant communities*. University of Wisconsin Press, 1971.
Classic study of the plant communities of Wisconsin. Establishes geographical limits, species compositions and as much as possible of the environmental relations of the communities composing the plant communities of Wisconsin. Generally avoids technical terms, so useful for non-specialists. Includes 270 maps, charts, tables and original photographs.

Duncan, Patricia. *Tallgrass prairies: The inland sea*. Lowell, 1978.

Gruchow, Paul. *Journal of a prairie year*. University of Minnesota Press, 1985.
Author's impressions through the four seasons, interlaced with snippets of prairie literature.

Kindscher, Kelly. *Edible wild plants of the prairie: An ethnobotanical guide*. University Press of Kansas, 1987.

Korling, Torkel. *Wild plants in flower: Habitat series: The prairie--swell and swale*. Korling, 1972.

Madson, John. *Tall grass prairie*. Falcon Press Publishing, 1993.
American history and natural science blended with stories and observations drawn from a lifetime on the prairie. Full-color photographs. Includes a directory listing outstanding tallgrass prairie preserves around the country.

Madson, John. *Where the sky began: Land of the tallgrass prairie*. Sierra Club Books, 1982.
An engaging narrative that blends history with natural science to give a sense of the prairie experience.

Reich, Binda. *Guide to the Arboretum prairies*. University of Wisconsin-Madison Arboretum, 1971 (out of print; available in Arboretum library).

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Runkel, Sylvan T. and Roosa, Dean M. *Wildflowers of the tallgrass prairie: The upper midwest.* Iowa State University Press, 1989.

Schaeffer, Elizabeth. *Dandelion, pokeweed, and goosefoot: How the early settler used plants for food, medicine, and in the home.* Young Scott Books, 1972.
Uses and origins of some native and European plants settlers used. Illustrated with plant descriptions and directions for an herb garden, collecting and drying plants, making teas and salads, dyeing cloth.

Field Guides

Courtenay, Booth and Zimmerman, James. *Wildflowers and weeds.* Simon & Schuster, 1992.

Fasset, Norman C. *Grasses of Wisconsin.* University of Wisconsin Press, 1951.
Covers taxonomy, ecology and distribution of grasses growing in WI without cultivation.

Fasset, Norman C. and Thompson, Olive S. *Spring flora of Wisconsin.* University of Wisconsin Press, 1976.

Newcomb, Lawrence. *Newcomb's wildflower guide.* Little, Brown, 1977.

The Peterson Field Guide Series. Houghton Mifflin.
The "Peterson System" is a visual system based on patternistic drawings with arrows to pinpoint key field marks and emphasize visual similarities and differences (taxonomic relationships are indicated in the appendix). There are nearly 50 volumes in this series, including ones on wildflowers, trees and shrubs, ferns, mammals, reptiles and amphibians, insects, animal tracks, birds, and bird nests.

Landscaping with Prairie and Other Native Plants

Aiken, George D. *Pioneering with wildflowers.* Self-published

Art, Henry W. *The wildflower gardener's guide: Midwest, Great Plains, and Canadian prairies edition.* Storey, 1991.
Overview of the prairie and its natural history as well as treatment of specific individual plants, including growing requirements.

Brooklyn Botanic Garden Record (Claire E. Sawyers, guest editor). *Gardening with wildflowers and native plants.* Brooklyn Botanic Garden, Handbook no. 119, 1989.
Collection of essays. Includes good definitions of native versus naturalistic, specific uses of natives (community plantings, ground covers, perennial borders, etc.), and features a number of institutions around the country where native plantings can be seen, including the UW-Madison Arboretum. Clearly distinguishes between native and nonnative in suggested plantings.

Curtis, Will C., revised by Brumback, William E. *Propagation of wildflowers.* New England Wildflower Society. Garden in the Woods, Framingham, Mass.

Diekelmann, John and Schuster, Robert. *Natural landscaping: Designing with native plant*

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Diekelmann, John and Schuster, Robert. *Natural landscaping: Designing with native plant communities*. McGraw-Hill, 1982.
Good introduction to natural plant communities (including prairie) as models for landscaping, and to the process of planning and establishing a natural landscape using a community approach. Includes planting and management information for private, public and corporate landscapes.

Druse, Ken. *Natural habitat garden*. Clarkson Potter.
Demonstrates through 500 full-color photographs of 35 gardens across the country not just how to garden with nature, but also how to establish eco-systems in miniature in our own back yard, creating beautiful native-plant gardens that can actually improve the health of the planet.

Eggers, Steve, and Reed, Don. *Wetland plants and plant communities of Minnesota and Wisconsin*. U.S. Army Corps of Engineers, St. Paul District Office.

Henderson, Carrol L. *Landscaping for wildlife*. Minnesota Dept. of Natural Resources, 1981.
Landowner's guide to developing backyard, farm and woodlot habitats for wildlife in the Midwest.

Nichols, Stan and Entine, Lynn. *Prairie primer*. University of Wisconsin Extension, 1978 (out of print; check with University Press for reprinting information).
This booklet provides an introduction to prairie ecology and 52 of the most common prairie forbs and grasses (organized by color, season and habitat preference), and a brief discussion of landscaping with prairie plants.

Ortho Books. *Landscaping with wildflowers and native plants*. Ortho Books, 1984.
Where to find seeds; how to take cuttings from wild plants; how to design a wildflower garden.

Phillips, Harry. *Growing and propagating wild flowers*. University of North Carolina Press, 1985.
Methods for raising natural plants from seeds, cuttings and division.

Shirley, Shirley. *Restoring the tallgrass prairie*. University of Iowa Press.

Smith, Robert J. Smith, Beatrice S. *The prairie garden: 70 native plants you can grow in town or country*. University of Wisconsin Press, 1980.
Good descriptions of needs and habitat, with lists of companion plants.

Smyser, Carol A. *Nature's design*. Rodale Press.

Sperka, Marie. *Growing wildflowers: A gardener's guide*. Harper & Row, 1973.
Good information for cultivation of both prairie and woodland plants.

Stein, Sarah. *Noah's garden*. Houghton Mifflin Company, 1993.
In setting out to restore the original ecology to a small plot of land, the author builds a garden that welcomes all creatures (humans, too).

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Stokes, Donald and Stokes, Lillian. *The wildflower book: An easy guide to growing and identifying wildflowers east of the Rockies*. Little, Brown and Company, 1992.
Somewhat simplistic; clearly distinguishes between native and nonnative species and emphasizes good conservation practices.

Xerces Society. *Butterfly gardening*. Sierra Club/Random House, 1990.

Prairie Restoration and Management

Ahrenhoerster, Robert and Wilson, Trelen. *Prairie Restoration for the Beginner*. North Lake, WI: Prairie Seed Source, 1981.
Booklet with good introduction to prairie history, information on aspects of restoration framed by a series of most-often-asked questions, and a list of selected remnant prairies and prairie restorations in North America.

Department of Forest Resources and Natural Heritage. *A guide to prairie restoration*. Illinois Department of Conservation, Springfield, IL, 1986.

Murray, Molly Fifield. *Prairie Restoration for Wisconsin Schools: A guide to restoration from site analysis to management*. University of Wisconsin-Madison Arboretum, 1993.
Shows how the process of ecological restoration enables people to learn about the cultural and natural history of the land, and to forge a positive relationship with it. Clearly outlines the process of restoration, which can be applied, following this guide, to ecosystems other than prairie. Includes helpful appendices of resources and references. To obtain, write or call the Arboretum, 1207 Seminole Hwy, Madison, WI 53711; (608) 263-7888.

Pauly, Wayne. *How to manage small prairie fires*. Dane County Highway and Transportation Department, 1985.
Excellent informational booklet detailing the planning necessary to conduct small prairie fires safely.

Restoration and Management Notes. Biannual journal, from 1981 to present. University of Wisconsin-Madison Arboretum.

Rock, Harold W. *Prairie propagation handbook*. Wehr Nature Center, Whitnall Park, Milwaukee County, WI, 1971.
In-depth, technical booklet. Covers seed and vegetative methods; includes list of nearly 300 prairie plants, with characteristics, habitat, seed harvest time, and recommended propagation methods.

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BIBLIOGRAPHY FOR TEACHERS AND OTHER LEADERS IN NATURAL SETTINGS

The books in the following sections do not always deal specifically with prairies, but they provide useful models and ideas for activities that can be adapted for prairie settings. There are many fine books for children that focus on aspects of environmental study and awareness. An important reference for locating these books is *E for Environment: An Annotated Bibliography of Children's Books with Environmental Themes*, by Patti K. Sinclaire (Bowker, 1992).

Awareness, Celebration, Enjoying and Sharing Nature

Baylor, Byrd. *I'm in charge of celebrations*. Macmillan, 1986. Fiction. Ages 6-9.
A young girl creates celebrations to express her enthusiasm for the beauty and wonder of her desert environment. Inspiring for those seeking to celebrate their observations and discoveries in natural settings.

Cornell, Joseph. *Sharing nature with children: A parents' and teachers' nature-awareness guidebook*. Ananda, 1979.
Fine collection of activities for children of various ages, sensitively structured with "children's lively energies" in mind. Includes section for parents and teachers on how to be an effective nature-guide and several prairie-related activities. Other excellent books by Cornell are *Listening to Nature: How to Deepen Your Awareness of Nature* (Dawn, 1987), and *Sharing the joy of nature: Nature Activities for All Ages* (Dawn, 1989).

Coutant, Helen. *The gift*. Knopf, 1983. Fiction, ages 7-10.
An elderly neighbor teaches Anna, a fifth grader, to observe and enjoy nature. When Anna learns her friend is blind, she brings her a special gift--her descriptions of the sights and sounds of a day she spent in the woods--thus returning the gift given to her, the ability to appreciate the natural world.

Herman, Marina Lachecki, Passineau, Joseph F., Schimpf, Ann L. and Treuer, Paul. *Teaching kids to love the earth*. Pfeifer-Hamilton, 1991.

Hollender, Jeffrey. *How to make the world a better place: A guide to doing good*. William Morrow, 1990.

Mitchell, John and the Massachusetts Audubon Society. *The curious naturalist*. Prentice-Hall, 1980.
Illustrated seasonal guide to outdoor nature activities and natural history information.

Rockwell, Robert E., Sherwood, Elizabeth A. and Williams, Robert A. *Hug a tree and other things to do outdoors with young children*. Gryphon House, 1986.

Silver, Donald M. *One small square backyard*. W. H. Freeman and Company, 1993.
Exploring the soil, animals and plants of a backyard using simple tools and a notebook.

Sisson, Edith A. *Nature with children of all ages: Activities and adventures for exploring, learning, and enjoying the world around us*. Prentice-Hall, 1982.

Van Matre, Steve. *Acclimatization: A sensory and conceptual approach to ecological involvement.* American Camping Association, 1972.
Other books about Acclimatization by Van Matre include *Acclimatizing: A personal and reflective approach to a natural relationship* (1974), *Sunship Earth: An Acclimatization program for outdoor learning*(1979), and *Earth education--A new beginning* (Institute for Earth Education, 1990).

Van Matre, Steve and Weiler, Bill, editors. *The earth speaks: An Acclimatization journal.* Institute of Earth Education, 1983.
A collection of readings by many different authors that stimulate natural awareness.

Natural History

Nardi, James B. *Close encounters with insects and spiders.* Iowa State University Press, 1988.

Stokes, Donald and Stokes, Lillian. *Stokes nature guides.* Little, Brown and Company.
Provide detailed discussions, with ample, detailed illustrations, to enhance the exploration of the natural world. Available: *Nature in Winter, Bird Behavior*, Vol. I, II, and III, *Observing Insect Lives, Amphibians and Reptiles*, and *Animal Tracking and Behavior*, and *Enjoying Wildflowers* (latter includes both native and nonnative plants).

Curriculum Guides, Classroom Projects and Activities

American Forest Council. *Project Learning Tree supplementary activity guide for grades K through 8.* American Forest Council, 1977.

Bowden, Marcia. *Nature for the very young.* John Wiley & Sons, 1989.
Activities for children from preschool age to second grade. Basic concepts appropriate to a young child plus guidance on leading a group of young children on field trips.

Braus, Judy. *NatureScope series.* National Wildlife Federation, 1400 Sixteenth St., NW, Washington, DC 20036-2266.
A series of 17 activity guides on various topics including pollution, wetlands, birds, mammals, endangered animals and many more.

[illegible] *nature through outdoor projects.* Stackpole Books, 1983.
Activities for observing wildlife in backyards, neighborhood woods, lawns and gardens, ponds, and streams.

Caduto, Michael J., and Bruchac, Joseph. *Keepers of the animals: Native American stories and wildlife activities for children.* Fulcrum, 1991.
For use with children ages five through twelve; includes storytelling tips and techniques, and activities presented in a lesson plan format that focuses on wildlife ecology and environmental issues concerning animals, all centered around a fine collection of 24 legends from 17 Native American cultures.

Caduto, Michael J., and Bruchac, Joseph. *Keepers of the animals teacher's guide*. Fulcrum, 1992.
A complement to *Keepers of the Animals*, this fleshes out the information provided in the Introduction and Part I. It also provides supplementary text and reading lists keyed to the chapters.

Caduto, Michael J., and Bruchac, Joseph. *Keepers of the earth: Native American stories and environmental activities for children*. Fulcrum, 1988.
For use with children ages five through twelve; includes storytelling tips and techniques, and activities presented in a lesson plan format that focuses on environmental themes, all centered around a fine collection of 25 legends from 20 Native American cultures.

Caduto, Michael J., and Burchac, Joseph. *Keepers of life: Discovering plants through Native American stories and earth activities for children*. Fulcrum, 1994.
For use with children ages five through twelve; includes storytelling tips and techniques, and activities presented in a lesson plan format that focuses on environmental and stewardship issues that affect plants in our modern world, all centered around a fine collection of 17 legends from 17 Native American cultures.

Cronin-Jones, Linda, ed. *Schoolyard wildlife activity guide*. Florida Game and Fresh Water Fish Commission, Nongame Education Coordinator, 620 S. Meridian Street, Tallahassee, FL 32399-9969, 1992.

Elementary science study (ESS) mapping teacher's guide. Delta Educational, PO Box M, Nashua, NH 03061, order #16-416-0353.

Galle, Janet R., and Warren, Patricia A. *Ecology discovery activities kit: a complete teaching unit for grades 4-8*. The Center for Applied Research in Education, West Nyack, NY, 1989.
A collection of 49 high-interest, hands-on activities to help teach important ecology concepts and science process skills. Lessons are ready-to-use and include worksheets and comprehensive teacher instructions. Designed for both the classroom and the field.

Hollweg, Karen. *Volunteers teaching children: A guide for establishing ecology education outreach programs*. Denver Audubon Society, 1991.
Describes community outreach programs developed in Denver and, subsequently, in seven other cities across the country. Program gives 8-12 year olds, especially those from the inner city, hands-on opportunities to discover and investigate nature right in their own neighborhoods.

Ingram, Mrill. *Bottle biology*. Kendall/Hunt Publishing Company, 1993.
An idea book with activities and teaching tips for exploring science and the environment with soda bottles and other recyclable materials.

Lingelbach, Jenepher. *Hands-on nature: Information and activities for exploring the environment with children*. Vermont Institute of Natural Science, Woodstock, VT 05091, 1986.
"Idea book" of activities and concepts covered in simplified way, with references for further, in-depth study. Covers adaptations, habitats, cycles, designs of nature

Norton, Mary and Joy. *Project LS: Land stewardship and lifestyle decisions (Iowa specific environmental education for ages 10 to adult).* Mary Norton, 1992. c/o Prairie Hills Farm, New Hartfor, IA 50660. (319) 983-2622.
A guide to improving understanding of Iowa's ecological heritage--the natural and unnatural processes that have made that environment what it is. Provides students with a basis for responsible decision making concerning the management of Iowa's natural resources.

O'Connor, Maura. *Living lightly on the planet: a global environmental education curriculum guide.* Schlitz Audubon Center, 1985. Schlitz Audubon Center, 1111 East Brown Deer Road, Milwaukee, WI 53217.
A K-12 curriculum series that serve as general activity guides for environmental topics.

Roth, Charles E., Cervoni, Cleti, Welnitz, Thomas, and Arms, Elizabeth. *Beyond the classroom: exploration of schoolyard and backyard.* Massachusetts Audubon Society, 1991.

Russell, Helen Ross. *Ten minute field trips: A teacher's guide to using the schoolgrounds for environmental studies.* National Science Teachers Association, 1742 Connecticut Avenue, N.W., Washington, D.C. 20009, 1990, second edition.

Schmidt, Victor E. and Rockcastle, Verne N. *Teaching Science with Everyday Things.* McGraw-Hill, 1968.

Soil conservation topics education kit. US Department of Agriculture.
Activities for grades K-2, 3-4, 5-6.

Wentworth, Counchman, MacBean, Stecher. *Mapping small places--examining your environment.* Holt, Rinehart, Winston of Canada, 1972.
From the excellent Examining Your Environment series, now out of print.

Western Regional Environmental Education Council. *Project WILD activity guide.* Second edition, 1992.
Contact your state wildlife agency. Includes elementary and secondary activity guides.

Wisconsin Department of Instruction. *A guide to curriculum planning in environmental education.* WI DPI, 1985.

Habitat Enhancement

Schiff, Paul, Smith-Walters, Dr. Cindi. *WILD school sites: A guide to preparing for habitat improvement projects on school grounds.* Project WILD, 1993.
Concepts in Project WILD (including awareness and appreciation, diversity of wildlife values, ecological principles, and responsible human action) form the basis for WILD school site projects. Emphasizes techniques for team building and creating and implementing the plan. Goal is to attract wildlife, therefore, although it encourages some use of native plants, it does not cover issues and considerations in selecting between native and nonnative species and does not recommend using only natives.

Interpretive Programs

Grinder, Alison L. and McCoy, E. Sue. *The good guide: A sourcebook for interpreters, docents and tour guides*. Ironwood Press, 1985.

Regnier, Kathleen Harris. *The nature fakir's handbook*. University of Wisconsin Stevens Point Press, 1988.

Regnier, Kathleen, Gross, Michael and Zimmerman, Ron. *The interpreter's guidebook: Techniques for programs and presentations*. University of Wisconsin Stevens Point Press, 1992.

Tilden, Freeman. *Interpreting our heritage*. University of North Carolina Press, 1977.

Trapp, Suzanne, Gross, Michael and Zimmerman, Ron. *Signs, trails, and wayside exhibits connecting people and places*. University of Wisconsin Stevens Point Foundation Press.

Voris, Helen H., Sedzielarz, Maija and Blackmon, Carolyn P. *Teach the mind, touch the spirit*. Field Museum of Natural History, Chicago, 1986.

Philosophy, Essays

Carson, Rachel. *Silent spring*. Houghton Mifflin, 1962.

Leopold, Aldo. *A Sand County almanac with essays on conservation from Round River*. Ballantine, 1990.

Muir, John. *Story of my boyhood and youth*. Houghton Mifflin, 1913.

Watts, May Theilgaard. "Prairie plowing match or the making and breaking of the tall grass sod" in *Reading the landscape of America*. Macmillan, 1975.

Wilson, Edward O. *Biophilia*. Harvard University Press, 1984.

FUNDING SOURCES FOR WISCONSIN SCHOOL RESTORATION PROJECTS

LOCAL RESOURCES

Persons seeking support for school restoration projects will find a wide variety of resources within their community that may provide funding and/or materials and equipment, such as plants and tools. Potential resources include local banks, service organizations such as Rotary and Kiwanis, community-based businesses and companies, business organizations such as Chambers of Commerce, and neighborhood associations.

GRANTS PROGRAMS

It may be possible to use funds available through the Eisenhower Math and Science Act, Title II to enable teachers to attend prairie restoration workshops and inservice sessions, or workshops on related topics. Check with your school district to see if it has Eisenhower funds and how to apply for them.

The Wisconsin Environmental Education Board (WEEB) makes annual grants for environmental education projects. Individual schools, consortiums and school districts are eligible to apply. Contact the Wisconsin Environmental Education Board, P.O. Box 781, Madison, WI 53707-7841, or call (608) 266-3155 for application information. Past grant deadlines have been in spring.

FOUNDATIONS

The following foundations give to one or more of the following: community funds, youth, schools, conservation/environmental projects. Policies for giving vary widely; contact each foundation to learn the specifics of its program. In cases where a specific community is listed under "Area Where Giving", check to see if the foundation also serves the region around that community.

Some foundations match employee contributions to non-profit groups; this is potentially an important source of funding. In many cases, while a foundation may not fund an individual school's project, it may fund a project developed by a consortium or school district, or one shared by a school and community groups (4H, scouts, city parks, local nature center).

This list was developed in part from information provided by the Wisconsin Environmental Education Board; addresses and telephone numbers were taken from The Foundation Directory, 1991 edition.

FOUNDATION	AREA WHERE GIVING
Appleton Papers	APPLETON, PORTAGE
Archer-Daniels-Midland Foundation P.O. Box 1470 Decatur, IL 62525 217-424-5200	WISCONSIN
Banc One Wisconsin Foundation 111 East Wisconsin Ave. P.O. Box 481 Milwaukee, WI 53201 414-765-2624	WISCONSIN

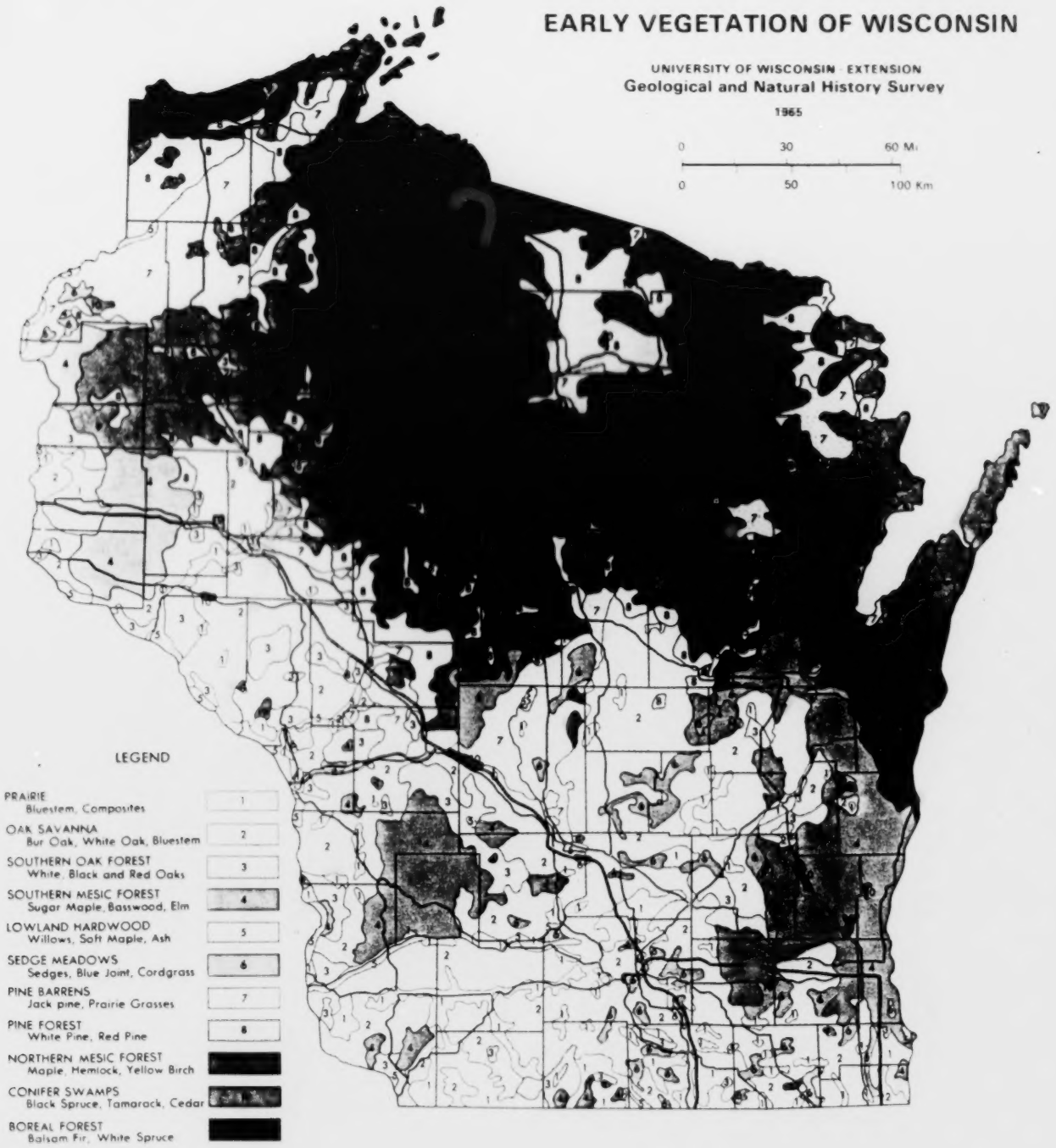
Banta Company Foundation, Inc. P.O. Box 8003 100 Main St. Menasha, WI 54952-8003 414-722-7771	MENASHA
Norman Bassett Foundation-Wisconsin 7601 Ganser Way Madison, WI 53719	MADISON, DANE COUNTY
Briggs & Stratton Corporation Foundation, Inc. 12301 West Wirth St. Wauwatosa, WI 53222 414-259-5333	GLENDALE, MENOMONIE FALLS, MILWAUKEE, WAUWATOSA, WEST ALLIS
Bucyrus-Erie Foundation, Inc. 1100 Milwaukee Ave. South Milwaukee, WI 53172 414-768-5005	MILWAUKEE
Burlington Northern Foundation 3000 Continental Plaza 777 Main St. Fort Worth, TX 76102	WISCONSIN
Consolidated Papers Foundation, Inc. 231 First Ave., North P.O.Box 8050 Wisconsin Rapids, WI 54495-8050 715-422-3368	ADAMS, BIRON, STEVENS POINT, WISCONSIN RAPIDS, WHITING
Patrick and Anna M. Cudahy Fund P.O. Box 11978 Milwaukee, WI 53211 414-271-6020 or 708-866-0760	MILWAUKEE
Community Foundation for the Fox Valley Region 222 West College Ave. P.O. Box 563 Appleton, WI 54912 414-730-3773	FOX VALLEY AREA
CUNA Mutual Insurance Group Charitable Foundation, Inc. 5910 Mineral Point Rd. Madison, WI 53705 608-231-7314	WISCONSIN
Edward U. Demmer Foundation c/o Bank One Wisconsin Trust Co., N.A. P.O. Box 1308 Milwaukee, WI 53201 414-765-2800	WISCONSIN

Ralph Evinrude Foundation, Inc. c/o Quarles and Brady 411 East Wisconsin Ave. Milwaukee, WI 53202-4497 414-277-5000	MILWAUKEE
The Evjue Foundation, Inc. 1901 Fish Hatchery Rd. P.O. Box 8060 Madison, WI 53708 608-252-6401	DANE COUNTY
First Star Milwaukee Foundation 777 East Wisconsin Ave. Milwaukee, WI 53202 414-765-4292 (formerly First Wisconsin Foundation, Inc.)	MILWAUKEE
Fort Howard Foundation, Inc. P.O. Box 11325 Green Bay, WI 54307-1325 414-435-8821 (Fort Howard Paper Corporation)	GREEN BAY
Great Northern Nekoosa Foundation, Inc. P.O. Box 5120 Norwalk, CT 06856-5120 203-845-9000	PORT EDWARDS
Heileman Old Style Foundation, Inc. 100 Harborview Plaza P.O. Box 459 Las Crosse, WI 54601 608-785-1000	LA CROSSE
Evan and Marion Helfaer Foundation 735 North Water St. Milwaukee, WI 53202 414-276-3600	WISCONSIN
International Paper Company Foundation Two Manhattanville Rd. Purchase, NY 10577 914-397-1581	DE PERE, MENASHA
Janesville Foundation, Inc. 121 North Parker Dr. P.O. Box 1492 Janesville, WI 53547 608-752-1032	JANESVILLE (exclusively)

The Johnson's Wax Fund, Inc. 1525 Howe St. Racine, WI 53403 414-631-2267	WISCONSIN
La Crosse Community Foundation P.O. Box 489 La Crosse, WI 54602-0489 608-782-3223	LA CROSSE COUNTY
Madison Community Foundation 615 East Washington Ave. Madison, WI 53703 608-255-1513	DANE COUNTY
Menasha Corporation Foundation P.O. Box 367 Neenah, WI 54956 414-751-1326	MENASHA
Badger Meter Foundation, Inc. 4545 West Brown Deer Rd. Milwaukee, WI 53223 414-355-0400	MILWAUKEE
The Steve J. Miller Foundation 15 North Central Ave. Marshfield, WI 54449	WISCONSIN
Milwaukee Foundation 1020 North Broadway Milwaukee, WI 53202 414-272-5805	MILWAUKEE
Minnesota Mining & Manufacturing Foundation, Inc. 3M Center, Bldg. 521-11-01 St. Paul, MN 55144-1000 612-736-3781 (3M Foundation)	CUMBERLAND, MENOMONIE, NEKOOSA, PRAIRIE DE CHIEN, WAUSAU, WISCONSIN RAPIDS
Norwest Foundation Norwest Ctr. Seventh and Marquette Minneapolis, MN 55479-1055 612-667-7860	APPLETON, LA CROSSE, MILWAUKEE, SHEBOYGAN
Oshkosh B'Gosh Foundation, Inc. P.O. Box 300 Oshkosh, WI 54902 414-231-8800	WISCONSIN

R.D. and Linda Peters Foundation, Inc. c/o Bank One Wisconsin Trust Co., N.A. P.O. Box 1308 Milwaukee, WI 53201 414-765-2800	BRILLION
Fred J. Peterson Foundation, Inc. 101 Pennsylvania St. Sturgeon Bay, WI 54235 414-743-5574	DOOR COUNTY
Pollybill Foundation, Inc. 735 North Water St., Suite 1328 Milwaukee, WI 53202 414-273-4390	MILWAUKEE
The Proctor & Gamble Fund P.O. Box 599 Cincinnati, OH 45201 513-983-3913 (local plant managers make recommendations)	GREEN BAY
Racine County Area Foundation, Inc. 818 Sixth St. Racine, WI 53403 414-632-8474	RACINE COUNTY
Walter Schroeder Foundation, Inc. 770 North Water St., Trust Dept. Milwaukee, WI 53202 414-287-7177	MILWAUKEE CO.
A.O. Smith Foundation, Inc. P.O. Box 23965 Milwaukee, WI 53223-0965 414-359-4100	WISCONSIN
Stackner Family Foundation, Inc. 411 East Wisconsin Ave. Milwaukee, WI 53202-4497 414-277-5000	MILWAUKEE
E.C. Styberg Foundation, Inc. P.O. Box 788 1600 Gould St. Racine, WI 53401-0788 414-637-9301	SOUTHEASTERN WI
Temple-Inland Foundation 303 South Temple Dr. P.O. Drawer 338 Diboll, Tx 75941 409-829-1313	MILWAUKEE

The Textron Charitable Trust P.O. Box 878 Providence, RI 02903 401-457-2430	RACINE
Time Insurance Foundation, Inc. 515 West Wells St. Milwaukee, WI 53203	MILWAUKEE
Union Camp Charitable Trust c/o Union Camp Corp. 1600 Valley Rd. Wayne, NJ 07470 201-628-2248	TOMAH
Vilter Foundation, Inc. 2217 South First St. Milwaukee, WI 53207	WISCONSIN
Vollrath Company Foundation, Inc. 1236 North 18th St. Sheboygan, WI 53081 414-457-4851	WISCONSIN
Wauwatosa Savings and Loan Foundation 7500 West State St. Wauwatosa, WI 53213 414-258-5880	WAUWATOSA
Wisconsin Energy Corporation, Inc. 231 West Michigan St. Milwaukee, WI 53201 414-221-2105	MILWAUKEE, SOUTHEASTERN WI
Wisconsin Power and Light Foundation, Inc. 222 West Washington Ave. Madison WI 53703 608-252-3181	CENTRAL AND SO-CENTRAL WI
Wisconsin Public Service Foundation, Inc. 700 North Adams St. P.O. Box 19001 Green Bay, WI 54307 414-433-1465	WISCONSIN
The Ziegler Foundation, Inc. 215 North Main St. West Bend, WI 53095 414-334-5521	WEST BEND



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INTERPRETATION OF THE VEGETATION OF WISCONSIN

This map is based on the original land survey conducted about the middle of the last century. Surveyors were required to place a stake each half mile, identified by notation of nearby trees, and to note briefly the general plant cover of each quarter section. These records have been used to reconstruct the presettlement distribution patterns of plant communities shown on the map.

The plant communities recognized, however, are based on systematic studies of present-day vegetation. The results of these studies are summarized in a recent book (J. T. Curtis, *The Vegetation of Wisconsin*, University of Wisconsin Press, 1959) in which each community, with its history, location, and relationship to other communities and to the environment, is considered in detail. Since some of the factors determining vegetation vary gradually, the vegetation itself varies gradually and boundaries on the map are somewhat arbitrary.

The vegetation of the state is divided into northern and southern floristic provinces by a line that runs in an S-curve northwest from Milwaukee to Hudson. North of this line the vegetation is a broadleaf forest containing conifers—pines, hemlock, spruces, and fir. Southwest of the line, conifers are much less important and are replaced by forests with several species of oaks, and by the prairies—areas dominated by grasses and tall herbs.

Fire has been important in determining almost all of the plant communities and their location. Before the coming of white man, the prairies (1) and the open woodlands burned almost every year. Thus most of the southern part of the state was covered with prairie or oak savanna (2), an orchard-like community with a few large bur or white oaks growing in fields of grass. Only in the more protected places did forests survive. Some of these were oak (3) but many were sugar maple-basswood-slippery elm forests (4). The lowlands were occupied by river bottom forest (5), and sedge meadow (6). With settlement, the fires were stopped, and the oak savannas grew up to the dense white oak-black oak forests found today. Most of the prairies have been cultivated, and at present, with the oak savannas, are among the rarest of our plant communities.

In the northern part of the state, a combination of fire and poor soil resulted in the development of pine barrens (7) on the sandy soils, and pine forests (8) on somewhat better soils. In the absence of fire, the white pine forests gradually changed to the northern equivalent of the sugar maple-basswood forests, a community containing sugar maple, yellow birch and hemlock, with beech added in the eastern counties (9). Also present in the north were large tracts of lowland, with tamarack and black spruce bogs in the wetter areas, and white cedar swamps in drier, but still very moist habitats (10). In the extreme north are local occurrences of the northern conifer forest (11) dominated by fir and spruce.

A comparison of this map with maps of climate, soil, and glacial deposits shows many correspondences, indicating many relationships between vegetation and the environment. The original vegetation was thus determined by the distribution of both climatic and soil factors, modified by fire.

G. Cottam, O. L. Loucks
Department of Botany
The University of Wisconsin

WISCONSIN PRAIRIE SPECIES LIST

Species marked with an asterisk (*) are listed as Endangered or Threatened in Wisconsin. A permit is required to sell, propagate or collect seeds of these species. Planting of these species into sites that may be confused with natural prairie remnants in the future is allowed only if documentation of the planting is provided to the Bureau of Endangered Resources, Wisconsin Department of Natural Resources.

Color Code

Pnk = Pink	Pur = Purple	Mag = Magenta	Ros = Rose	Brn = Brown	Vlt = Violet
Crm = Cream	Lav = Lavender	Red = Red	Org = Orange	Blu = Blue	Grn = Green
Wht = White					

Habitat Code

PD = Dry Prairie
PDM = Dry Mesic Prairie
PM = Mesic Prairie
PWM = Wet Mesic Prairie
PW = Wet Prairie
Ca = Species which are believed to do best on calcareous soils, characterized by having high levels of calcium/magnesium and high pH. In dry prairies and dry-mesic prairies, these species are found in limestone bluffs in the driftless area.

Light

Su = Full sun
Ps = Partial shade
Sh = Shade

Germination Treatment Code

Germination treatments are based on practical experience gained by propagating many of these species at commercial wildflower nurseries by Brian Bader and Alan Wade. Treating seed to improve germination is most beneficial when propagating plants where even germination is desired. Seed which is to be broadcast into a restoration generally should not be treated, unless irrigation is possible. While not always obvious, the goal of treating seed is to mimic the conditions the seed experiences after it is dispersed from the parent plant in winter. Much can be gained by observing the species and the natural conditions in which it does best.

WS = Wet Stratification. Mix seeds with moist sawdust, vermiculite or clean sand and store at 34° - 38° F. Species with this type of treatment may germinate without stratification, leading some to conclude that no treatment is necessary. Often seed germination will be enhanced with stratification.
WWS = Warm Wet Stratification. Mix seeds with moist sawdust, vermiculite or clean sand and store at 50° - 60° F.
DS = Dry Stratification. Store seeds in unheated shed or garage overwinter.
Sc = Scarification. Scratch seed coats.
In = Inoculate with rhizobium bacterium (applied to legumes).
Fr = Plant fresh seed.
Fa = Plant seed in fall.
-ES = Plant seed in early spring, seed germinates best with cool soil temperatures.
-Wa = Plant seed when soil temperatures are warm.
-Lt = Seed germination is improved with light, do not cover seeds, simply firmly press into soil.
( ) = Number of days for treatment.
H20 = Hot water treatment. Soak seed in boiling water for 1-2 minutes.

Examples:

WS(30-60) = Wet stratify seed for 30-60 days
WWS(90)/WS(90) = Warm wet stratify seed for 90 days followed by cold wet stratification for 90 days
WS(60)-ES = Wet stratify seed for 60 days and plant in early spring.
WS(30)-Wa = Wet stratify seed for 30 days and plant when soil temperatures are warm.
WS(30)-Lt = Wet stratify seed for 30 days, do not cover seed when planting
WS(30-60),In,Sc = Seed should be scarified and inoculated and wet stratified for 30-60 days.
H20+WS(90) = Soak seeds in hot water for 1-2 minutes followed by 90 days cold wet stratification.

Comments Code

Rh = Rhizomatous species
SL-Per = Short-lived perennials
Weedy = Not recommended for planting. May come in without planting

References

Henderson, R.A. 1993. Plant Species Composition of Wisconsin Prairies: An Aid to Selecting Species for Plantings and Restorations. WI DNR

Wade, Alan, 1993. Prairie Moon Nursery Catalog and Cultural Guide

WISCONSIN PRAIRIE SPECIES LIST

Scientific Name	Common Name	Bloom	Color	Height	Habitat	Light	Germination Tmt	Comments
Achillea millifolium	Yarrow	Jun-Oct	Wht	8"-40"	PD-PW	Su	DS or WS(30)	Rh, SL-Per
Agalinis aspera	Rough false foxglove	Aug-Sep	Pnk-Pur	16"-32"	PD-PW	Su		
Agalinis gattingeri*	Gattingers false foxglove	Aug-Sep	Pnk-Pur	16"-32"	PWM	Ps,Su		
Agropyron trachycaulum	Slender wheatgrass			1'-3'	PDM-PWM	Su,Ps,Sh	DS	
Allium canadense	Wild garlic	May-Jun	Pnk	6"-24"	PDM-PWM	Su,Ps	None	
Allium cernuum	Nodding wild onion	Jul-Aug	Lav,Wht	10"-20"	PM-PWM	Su	WS(30-60) or Fr	
Ambrosia artemisiifolia	Common ragweed	Jul-Oct	Gre	1'-3'	PD-PW	Su	None	Annual Weed
Ambrosia psilostachya	Western ragweed	Jul-Aug	Gre	1'-3'	PD-PDM	Su	None	SL-Per
Ambrosia trifida	Giant ragweed	Jul-Oct	Gre	6'	PD-PW	Su	None	Annual Weed
Amorpha canescens	Leadplant	Jun-Aug	Pur	20"-40"	PD-PWM	Ps,Su	WS(30),In,Sc	
Amphicarpa bracteata	Hog peanut	Aug-Sep	Wht,Lav	6"-60"	PDM-PW	Ps		Twining vine
Andropogon gerardi	Big bluestem	Aug-Sep		3'-8'	PD-PW	Su	DS	
Anemone canadensis	Meadow anemone	May-Jun	Wht	8"-32"	PM-PW	Su	WS(30-60)	Rh
Anemone cylindrica	Thimbleweed	Jun-Aug	Wht	1-3'	PD-PWM	Su,Ps,Sh	WS(90)-Es or Fa	
Anemone patens	Pasque flower	Apr	Lav	4"-16"	PD-PDM,C	Su	WS(90)-ES or Fa	
Anemone quinquefolia	Wood anemone	Apr-Jun	Wht	4"-8"	PDM-PW	Ps	WS (60-90)-Wa	
Angelica atropurpurea	Great angelica	May-Jun	Wht	2'-8'	PWM-PW,	Su,Ps	WS(90)-ES or Fa	
Antennaria spp.	Pussytoes	Apr-Jul	Wht	4"-16"	PD-PW	Su,Ps	WS(30-60)	
Apios americana	Ground nut	Jul-Aug	Brn-Pur	7'	PWM-PW	Sh,Ps		Rh, twining
Apocynum androsaemifolium	Spreading dogbane	Jun-Aug	Pnk	8"-24"	PD-PW	Ps,Su		
Apocynum cannibinum	Indian hemp	Jun-Sep	Wht/Gre	3'-5'	PDM-PW	Su		
Aquilegia canadensis	Wild columbine	May-Jun	Red/Yel	1'-3'	PD-PDM,C	Ps,Su	WS(30)	
Arabis lyrata	Sand cress	May-Jul	Wht	4"-16"	PD-PDM	Su,Ps	Fr-Lt	Biennial/SL-Per
Arenaria lateriflora	Wood sandwort	May-Jul	Wht	4"-12"	PWM	Ps,Sh	WS(30-60) or Fr	Rh
Arenaria stricta	Stiff sandwort	Jun-Sep	Wht	4"-16"	PD	Su	WS(30-60) or Fr	Annual/SL-Per
Artemesia caudata	Beach wormwood	Jul-Oct	Gre	1'-4'	PDM-PM	Su,Ps		Biennial
Artemisia frigida	Prairie sagewort	Jul-Sep	Gre	4"-16"	PD-PDM	Su		
Artemisia ludoviciana	White sage	Jul-Sep	Gre/Wht	1'-3'	PDM-PWM	Su		Rh
Artemisia serrata	Saw-toothed sagebrush	Aug-Oct	Gre	3'-6'	PWM	Su,Ps		Rh
Asclepias amplexicaulis	Blunt-leaved milkweed	Jun-Aug	Wht/Pnk	1'-3'	PDM-PWM	Su,Ps	WS(30-60)	
Asclepias hirtella	Tall Green milkweed	Jun-Aug	Gre	16"-40"	PDM,PM-P	Su	WS(30-60)	
Asclepias incarnata	Swamp milkweed	Jul-Aug	Red/Wht	1'-4'	PWM-PW	Su	WS(30-60)	
Asclepias lanuginosa*	Wooly milkweed	May-Jun	Pur	6"-12'	PD-PDM	Su,Ps		
Asclepias ovalifolia	Oval milkweed	Jun-Jul	Gre/Wht	8"-24"	PDM-PWM	Su,Ps		
Asclepias purpurascens*	Purple milkweed	Jun-Jul	Pur	2'-3'	PM-PWM	Ps,Su		

WISCONSIN PRAIRIE SPECIES LIST

Scientific Name	Common Name	Bloom	Color	Height	Habitat	Light	Germination Tmt	Comments
Asclepias sullivantii*	Prairie milkweed	Jun-Jul	Pur-Wht	2'-5'	PM-PWM,C	Su		Rh
Asclepias syriaca	Common milkweed	Jun-Aug	Crm-Pnk	1.5'-6'	PD-PW	Su,Ps	WS(30) or none	Rh
Asclepias tuberosa	Butterflyweed	Jul-Sep	Org	1'-3'	PD-PM	Su,Ps	WS(30-60)	
Asclepias verticillata	Whorled milkweed	Jun-Aug	Wht	8"-20"	PD-PWM	Su,Ps	WS(30) or none	
Asclepias viridiflora	Short green milkweed	Jul-Aug	Gre	1'-3'	PD-PWM	Su,Ps		
Aster azureus	Sky blue aster	Aug-Oct	Blu	1'-4'	PD-PW	Su,Ps	WS(30-60)-ES	
Aster ericoides	Heath aster	Aug-Oct	Wht	6"-36"	PD-PWM	Su,Ps	WS(30-60)-ES	Rh
Aster laevis	Smooth aster	Aug-Oct	Blu	1'-3'	PD-PWM	Su,Ps	WS(30-60)-ES	
Aster linariifolius	Stiff-leaved aster	Jul-Oct	Vlt	4"-20"	PD-PDM	Su,Ps	WS(30-60) or Fa	
Aster lucidulus		Aug-Oct	Blu/Lav	1'-7'	PWM-PW	Su		Rh
Aster novae-angliae	New England aster	Aug-Oct	Blu/Pur	1'-7'	PM-PW	Su,Ps	WS(30-60)-ES	
Aster oblongifolius	Aromatic aster	Sep-Oct	Blu/Pur	4"-40"	PD-PDM,C	Su	WS(30-60) or Fa	Rh
Aster pilosus	Hairy aster	Aug-Nov	Wht	1'-5'	PM-PWM	Su	WS(30-60) or Fr	
Aster ptarmicoides	Stiff aster	Jul-Sep	Wht	3"-24"	PD-PDM,C	Su	WS(30-60)	
Aster sagittifolius	Arrow-leaved aster	Aug-Oct	Wht/Blu	1'-4'	PM-PWM	Sh,Ps,Su	WS(30-60) or Fa	
Aster sericeus	Silky aster	Aug-Oct	Pur/Vlt	8"-24"	PD-PM	Su	WS(30-60) or Fa	
Aster simplex	Panicled aster	Aug-Oct	Wht	2'-6'	PWM-PW	Su	WS(30-60)	Rh
Aster umbellatus	Flat top aster	Jul-Sep	Wht	1'-7'	PWM-PW	Su	WS(30-60)	Rh
Astragalus canadensis	Canadian milk vetch	Jul-Aug	Wht	1'-4'	PDM-PWM	Ps,Su	WS(60),Sc,In	Rh
Astragalus crassicarpus*	Prairie plum	Apr-May	Pur-Wht	8"-20"	PDM	Su		
Baptisia leucantha	White wild indigo	Jun-Jul	Wht	3'-6'	PD-PWM	Su	WS(90),Sc,In	
Baptisia leucophaea	Cream wild indigo	May-Jun	Crm	10"-32"	PD-PWM	Su,Ps	WS(90),Sc,In	
Besseya bullii*	Kittentails	May	Gre	8"-16"	PDM	Su	WS(120) or Fa	
Blephilia ciliata	Ohio horse mint	Jun-Aug	Pur	16"-32"	PWM-PW	Ps	WS(30-60)	
Bouteloua curtipendula	Sideoats grama grass			12"-40"	PD-PM	Su,Ps	DS	
Bouteloua hirsuta	Hairy grama grass			6"-24"	PD-PDM	Su	DS	
Bromus ciliatus	Fringed brome			2'-4'	PW	Sh,Ps,Su	DS	
Bromus kalmii	Prairie brome			20"-40"	PDM-PWM	Sh,Ps,Su	DS	
Cacalia atriplicifolia	Pale indian plantain	Jul-Sep	Wht	3'-9'	PM-PWM	Ps,Su	WS(30-60)	
Cacalia suaveolens	Sweet indian plantain	Jul-Aug	Wht	2'-5'	PM, PW	Su,Ps	WS(30-60)	
Cacalia tuberosa*	Prairie indian plantain	Jul-Aug	Wht	2'-5'	PDM-PW	Ps,Su	WS(30-60)	
Calamogrostis canadensis	Bluejoint grass			2'-5'	PM-PW	Su	DS	Rh
Callirhoe triangulata	Poppy mallow	Jun-Aug	Mag	3"-24"	PD-PDM	Su,Ps	WS(30)	
Caltha palustris	Marsh marigold	Apr-May	Yel	8"-24"	PWM-PW	Su,Ps,Sh	WS(30-60)	
Camassia scilloides	Wild hyacinth	Apr-May	Vlt/Wht	1'-2'	PWM	Su,Ps	WS(60-90),Fa	

WISCONSIN PRAIRIE SPECIES LIST

Scientific Name	Common Name	Bloom	Color	Height	Habitat	Light	Germination Tmt	Comments
Campanula aparinoides	Marsh bell flower	Jun-Aug	Blu/Wht	12"-40"	PWM-PW	Su		Rh
Campanula rotundifolia	Harebell	Jun-Sep	Blu	4"-20"	PD-PDM	Ps,Su	WS(30-60)-Lt	
Carex bicknellii	Bicknell's sedge			20"-40"	PM-PW	Su		
Carex muhlenbergii	Sand sedge			8"-40"	PDM	Su		
Carex pensylvanica	Pennsylvania sedge			8"-16"	PDM-PW	Sh,Ps,Su		Rh
Cassia fasciculata	Partridge pea	Jul-Sep	Yel	4"-16"	PDM-PM	Su	DS or WS(30),In	Annual
Castilleja coccinea	Indian paintbrush	May-Aug	Red-Yel	5"-24"	PM-PW	Su		Annual
Castilleja sessiliflora	Downy paintbrush	May-Jul	Yel/Wht	5"-12"	PD-PDM,C	Su		
Ceanothus americanus	New jersey tea	Jun-Aug	Wht	1'-3'	PDM-PWM	Su,Ps	H20+WS(90)	Shrub
Ceanothus ovatus	Prairie redroot	May-Jun	Wht	1'-3'	PDM	Su	H2O+WS(90)	Shrub
Chelone glabra	Turtlehead	Jul-Sep	Crm	2'-3'	PW	Su,Ps,Sh	WS(120) or Fa	
Chrysopsis villosa	Golden aster	Jul-Oct	Yel	8"-40"	PD	Su		
Cicuta maculata	Water hemlock	Jun-Aug	Wht	2'-7'	PWM-PW	Su	WS(120) or Fa	
Cirsium discolor	Field thistle	Jul-Oct	Pur-Lav	3'-7'	PDM-PW	Su		SL-Per
Cirsium hillii*	Prairie thistle	Jun-Aug	Pur	1'-3'	PDM	Su		
Cirsium muticum	Swamp thistle	Jul-Oct	Pur	2'-7'	PWM-PW	Su,Ps,Sh		Biennial
Comandra umbellata	False toadflax	May-Jul	Wht	4"-12"	PD-PW	Su,Ps		Rh, parasitic
Convolvulus sepium	Hedge bindweed	Jun-Sep	Pnk/Wht	-10'	PD-PW	Su,Ps		Twining vine, weedy
Convolvulus spithameus	Low bindweed	May-Jul	Wht/Pnk	3"-20"	PDM	Su,Ps		Twining vine, weedy
Coreopsis palmata	Stiff coreopsis	Jun-Jul	Yel	20"-36"	PD-PWM	Su,Ps	WS(30-60)	Rh
Cyperus lupulinus	Flat sedge				PDM			
Cyperus schweinitzii	Flat sedge			8"-32"	PDM	Su,Ps		Rh
Cypripdeium calceolus	Yellow lady's slipper	May-Jul	Yel	8"-32"	PM-PWM	Sh,Ps	Difficult	Orchid
Cypripedium candidum*	White lady's slipper	May-Jun	Wht	6"-16"	PWM-PW,	Su,Ps	Difficult	Orchid
Delphinium virescens	Prairie larkspur	Jun-Jul	Wht	16"-48"	PDM	Su	WS(30-60) or Fa	
Desmodium canadense	Showy tick-trefoil	Jul-Aug	Pur	3'-6'	PDM-PW	Su,Ps	WS(30-60),Sc,In	
Desmodium illinoense	Illinois tick-trefoil	Jul-Aug	Pur	3'-6'	PD-PWM	Su	WS(30-60),Sc,In	
Dodecatheon meadia	Shootingstar	May-Jun	Wht/Lav	8"-24"	PDM-PW	Ps-Su	WS(60)-ES or Fa	
Draba reptans	Common whitlow-grass	Apr-May	Wht	2"-8"	PDM	Su	Fr-Lt	Annual
Echinacea pallida*	Pale purple coneflower	May-Aug	Lav	24"-40"	PDM-PM	Su	WS(30-60)	
Elymus canadensis	Canada wild rye			3'-6'	PD-PWM	Su,Ps	DS	
Elymus virginicus	Virginia wild rye			2'-4'	PWM	Ps,Su	DS	
Equisetum arvense	Field horsetail			6"-24"	PM-PW	Su	Spores	
Equisetum hyemale affine	Common scouring-rush			8"-60"	PD-PDM	Su	Spores	
Equisetum laevigatum	Smooth scouring-rush			12"-40"	PDM-PW	Su	Spores	

WISCONSIN PRAIRIE SPECIES LIST

Scientific Name	Common Name	Bloom	Color	Height	Habitat	Light	Germination Tmt	Comments
Erigeron philadelphicus	Marsh fleabane	Jun-Jul	Wht	8"-28"	PWM-PW	Su,Ps,Sh	None	Biennial, weedy
Erigeron strigosus	Daisy fleabane	Jun-Jul	Wht	12"-28"	PD-PW	Su,Ps,Sh	None	Annual, weedy
Eriophorum virginicum	Rusty cotton grass			6'	PW	Su,Ps		
Eryngium yuccifolium	Rattlesnake master	Jul-Aug	Wht/Grn	3'	PDM-PWM	Su,Ps	WS(30-60)	
Eupatorium altissimum	Upland boneset	Aug-Oct	Wht	3'-6'	PM	Su,Ps	WS(30-60)-Lt	
Eupatorium maculatum	Spotted joe-pye Weed	Jul-Sep	Ros	2'-6'	PWM-PW,	Su	WS(30-60)-Lt	
Eupatorium perfoliatum	Common boneset	Jul-Oct	Wht	2'-5'	PWM-PW	Su	WS(30-60)-Lt	
Euphorbia corollata	Flowering spurge	Jun-Sep	Wht	12"-40"	PD-PW	Su,Ps	WS(30-60)	Rh
Fragaria virginiana	Wild strawberry	Apr-Jun	Wht	4"-6"	PDM-PW	Ps,Su		Rh
Galium boreale	Northern bedstraw	Jun-Jul	Wht	8"-40"	PDM-PW	Su,Ps		
Galium tinctorium	Stiff bedstraw	Jun-Sep	Wht		PWM-PW	Su,Ps		Forms mats
Gaura biennis	Biennial gaura	Aug-Sep	Pnk	3'-6'	PDM-PWM	Su,Ps	WS(30-60)	Biennial
Gentiana alba*	Yellowish gentian	Aug-Sep	Crm	20"-36"	PM-PWM	Ps,Su	WS(30-60)-Wa-Lt	
Gentiana andrewsii	Bottle gentian	Aug-Oct	Blu	16"-32"	PM-PW	Su,Ps	WS(30-60)-Wa-Lt	
Gentiana puberulenta	Downy gentian	Aug-Oct	Blu	8"-20"	PDM-PM,C	Su,Ps	WS(30-60)-Wa-Lt	
Gentianella quinquefolia	Stiff gentian	Aug-Sep	Pur	8"-16"	PDM-PM	Su,Ps	WS(60-90)-Wa-Lt	Annual/Biennial
Gentianopsis crinita	Fringed gentian	Aug-Oct	Blu	12"-32"	PWM-PW	Su,Ps	WS(30-60)-Wa-Lt	Annual/Biennial
Gentianopsis procera	Small fringed gentian	Aug-Oct	Blu	12"-32"	PWM-PW,	Su,Ps	WS(30-60)-Wa-Lt	Annual/Biennial
Geranium maculatum	Wild geranium	Apr-Jun	Lav	12"-28"	PD-PW	Ps,Su	WS(60-90),Sc	Rh
Gerardia spp.								= AGALINIS
Geum aleppicum	Yellow avens	May-Jul	Yel	20"-40"	PM-PWM	Su,Ps	WS(30-60)	Weedy
Geum canadense	White avens	May-Jun	Wht	16"-36"	PW	Ps,Su		Weedy
Geum triflorum	Prairie smoke	Apr-Jun	Red	4"-16"	PD-PWM	Su,Ps	WS(60)-ES or Fr	Rh
Glyceria striata	Fowl meadow grass			2'-4'	PW	Su		
Gnaphalium obtusifolium	Sweet everlasting	Jul-Oct	Wht	4"-32"	PDM	Su	WS(30-60)	Aromatic annual
Grindelia squarrosa	Gumplant	Aug-Sep	Yel	4"-40"	PDM	Su		Biennial
Habenaria spp.								= Platanthera
Hedeoma hispida	Rough pennyroyal	May-Aug	Lav	4"-16"	PD-PDM	Su		Annual
Helenium autumnale	Sneezeweed	Aug-Oct	Yel	2'-5'	PWM-PW	Su		
Helianthemum canadense	Frostweed	May-Jun	Yel	8"-24"	PD-PM	Su,Ps	WS(90)-Lt	
Helianthus grosseserratus	Sawtooth sunflower	Jul-Oct	Yel	3'-12'	PDM-PW	Su	WS(30)	Rh, weedy
Helianthus laetiflorus	Prairie sunflower	Aug-Sep	Yel	2'-6'	PD-PWM	Su	WS(30)	Rh, aggressive
Helianthus occidentalis	Western sunflower	Jul-Sep	Yel	2'-6'	PD-PM	Su,Ps	WS(30)	Rh
Helianthus strumosus	Woodland sunflower	Jul-Sep	Yel	3'-6'	PM-PWM	Sh,Ps	WS(30)	Rh
Heliopsis helianthoides	Ox-Eye sunflower	Jul-Sep	Yel	2'-5'	PDM-PW	Su,Ps	WS(30)	SL-Per

WISCONSIN PRAIRIE SPECIES LIST

Scientific Name	Common Name	Bloom	Color	Height	Habitat	Light	Germination Tmt	Comments
Heuchera richardsonii	Prairie alumroot	Jun-Jul	Grn	1'-3'	PDM-PW	Su,Ps	WS(90)-ES or Fa	
Hieracium canadense	Canada hawkweed	Jul-Oct	Yel	.5'-5'	PDM-PW	Su,Ps	WS(30-60)	
Hieracium longipilum	Hairy hawkweed	Jul-Aug	Yel	2'-5'	PD-PDM	Su	WS(30-60)	
Hierochloe odorata	Sweet grass			12"-20"	PWM-PW	Su,Ps	DS	
Houstonia caerulea	Bluets	Jun	Blu/Wht	2"-8"	PW	Su		
Houstonia longifolia	Long-leaved bluets	Jun-Aug	Wht	4"-10"	PDM	Su,Ps		
Hypericum canadense	Canadian st johnswort	Jul-Sep	Yel	4"-16"	PM	Su		Annual
Hypericum mutilum	Weak st johnswort	Jul-Sep	Yel	4"-32"	PM	Su		Annual
Hypoxis hirsuta	Yellow star grass	Apr-Jul	Yel	4"-12"	PDM-PW	Su,Ps	WS(30-60) or Fr	
Iris virginica shervei	Blue flag iris	May-Jul	Blu	1'-3'	PWM-PW	Su,Ps	WS(120) or Fa	
Koeleria cristata	June grass			1'-2'	PD-PM	Su,Ps	DS	
Krigia biflora	Cynthia	Apr-Jun	Yel	8"-32"	PM-PW	Su,Ps		
Krigia virginica	Dwarf dandelion	Apr-Jun	Yel	2"-16"	PDM	Su		
Kuhnia eupatorioides	False boneset	Aug-Oct	Crm	1'-4'	PD-PDM,C	Su,Ps	WS(30-60) or Fr	
Lactuca canadensis	Wild lettuce	Jul-Sep	Yel	1'-8'	PD-PWM	Su,Ps		Annual/Biennial
Lactuca ludoviciana	Western wild lettuce	Jul-Sep	Yel	1'-5'	PD-PM	Su,Ps		Biennial,SL-Per
Lathyrus palustris	Marsh vetchling	Jun-Jul	Lav	1'-4'	PWM-PW	Su,Ps	WS(30),Sc,In	Rh
Lathyrus venosus	Veiny pea	Jun-Jul	Lav	2'-3'	PDM-PW	Su,Ps,Sh	WS(30),Sc,In	Rh
Lechea intermedia	Intermediate pinweed	Jul-Sep	Red	8"-24"	PDM	Su,Ps		
Lechea tenuifolia	Slender-leaved pinweed	Jul-Sep	Red	3"-12"	PD-PM	Su,Ps		
Leptoloma cognatum	Fall witch grass			16"-28"	PDM	Su		
Lespedeza capitata	Round-headed bush clover	Jul-Sep	Wht	2'-4'	PD-PM	Su,Ps	WS(60),Sc,In	
Liatris aspera	Rough blazingstar	Aug-Oct	Mag	16"-48"	PD-PM	Su	WS(30-60)	
Liatris cylindracea	Dwarf blazingstar	Jul-Sep	Mag	8"-24"	PD-PDM	Su	WS(30-60)	
Liatris ligulistylis	Showy blazingstar	Aug-Sep	Pur	1'-4'	PM	Ps,Su	WS(30-60)	
Liatris punctata*	Dotted blazingstar	Jul-Sep	Ros	4"-32"	PD-PDM	Su	WS(30-60)	
Liatris pycnostachya	Prairie blazingstar	Jul-Sep	Mag	2'-5'	PM-PW	Su,Ps	WS(30-60)	
Liatris spicata	Marsh blazingstar	Jul-Sep	Mag	2'-6'	PM-PWM	Su	WS(30-60)	
Lilium michiganense	Turk's cap lily	Jul-Aug	Org	3'-6'	PM-PW	Ps,Su	WWS(90)/WS(90)	
Lilium philadelphicum	Wood lily	Jun-Aug	Org	1'-3'	PDM-PW	Ps,Su	WWS(90)/WS(90)	
Linum sulcatum	Grooved yellow flax	Jun-Jul	Yel	8"-32"	PD	Su,Ps	DS or WS(30)	Annual
Liparis lowselii	Green twayblade	Jun-Jul	Yel	4"-10"	PW	Sh,Ps	Difficult	Orchid
Lithospermum canescens	Hoary puccoon	Apr-Jun	Org	4"-18"	PD-PWM	Su,Ps	Fa orWS(120),Sc	
Lithospermum caroliniense	Hairy puccoon	May-Jul	Yel	6"-24"	PD-PDM	Su,Ps	Fa orWS(120),Sc	
Lithospermum incisum	Fringed puccoon	May-Jun	Yel	4"-20"	PD-PDM,C	Su		

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WISCONSIN PRAIRIE SPECIES LIST

Scientific Name	Common Name	Bloom	Color	Height	Habitat	Light	Germination Tmt	Comments
Lobelia kalmii	Bog lobelia	Jul-Sep	Lav/Pnk	4"-16"	PWM,Ca	Su		
Lobelia siphilitica	Great blue lobelia	Aug-Sep	Blu	1'-4'	PW	Su	WS(30-60)-Lt	
Lobelia spicata	Pale spiked lobelia	Jun-Jul	Blu/Wht	12"-40"	PD-PW	Su,Ps	WS(30-60)-Lt	
Lupinus perennis	Wild lupine	May-Jun	Blu	8"-24"	PDM-PM	Su,Ps	WS(30),Sc or Fr	
Lycopus americanus	Common water horehound	Jul-Sep	Wht	4"-40"	PWM-PW	Su,Ps		
Lycopus uniflorus	Northern bugle weed	Jul-Sep	Wht	4"-40"	PWM-PW	Su,Ps		
Lysimachia ciliata	Fringed loosestrife	Jun-Jul	Yel	10"-4-"	PWM-PW	Su		
Lysimachia lanceolata	Lance-leaved loosestrife	Jun-Jul	Yel	1'-2'	PDM-PWM	Ps,Su		Rh
Lysimachia quadriflora	Prairie loosestrife	Jul-Aug	Yel	1'-2'	PWM-PW,	Su	WS(30-60)	
Lysimachia quadrifolia	Whorled loosestrife	Jun-Jul	Yel	1'-3'	PWM-PW	Ps,Su		
Lythrum alatum	Winged loosestrife	Jun-Sep	Pur	16"-48"	PWM-PW	Su	WS(30-60)	
Microseris cuspidata	Prairie dandelion	Apr-May	Yel	3"-12"	PDM-PM	Su		
Mirabilis nyctaginea	Wild four o'clock	May-Aug	Ros	1'-3'	Pd-PW	Su		
Monarda fistulosa	Wild bergamot	Jul-Sep	Lav	2'-4'	PD-PW	Su,Ps	WS(30)	
Monarda punctata	Horse mint	Jul-Sep	Lav	6"-36"	PD-PDM	Su	DS or WS(30)	Biennial/Sl-Per
Muhlenbergia cuspidata	Prairie satin grass			8"-28"	PD-PDM	Su	DS	
Muhlenbergia racemosa	Upland wild timothy			2'-4'	PM-PW	Su	DS	Rh
Napaea dioica	Glade mallow	Jun-Aug	Wht	3'-6'	PWM-PW	Ps,Su	WS(30-60)	
Oenothera biennis	Common evening primrose	Jul-Oct	Yel	2'-6'	PD-PWM	Su	Fa or WS(30)	Biennial/SL-Per
Oenothera perennis	Small sundrops	May-Jul	Yel	6"-24"	PW	Su,Ps		
Oenthera rhombipetala	Sand primrose	Jun-Sep	Yel	16"-40"	PDM	Su	WS(30-60)	
Onoclea sensibilis	Sensitive fern			3'	PW	Ps,Su	Spores	Fern
Ophioglossum vulgatum	Adder's Tongue fern			3"-15"	PW	Sh,Ps,Su	Spores	Fern
Opuntia compressia	Prickly pear cactus	Jun-Jul	Yel	2"-8"	PD-PDM	Su	None	
Orobanche fasciculata*	Clustered broom rape	May-Aug	Crm	2"-6"	PDM	Su		Parasitic
Oxalis stricta	Tall wood sorrel	Jun-Oct	Yel	5"-20"	PM	Su,Ps		Rh
Oxalis violacea	Violet wood sorrel	Apr-Jun	Lav	4"-6"	PDM-PW	Ps,Su		
Oxypolis rigidior	Cowbane	Jul-Sep	Wht	2'-5'	PWM-PM	Su	WS(120) or Fa	Poisonous
Panicum leibergii	Prairie panic grass			1'-2'	PD-PWM	Su,Ps	DS	
Panicum oligosanthes	Scribner's panic grass			8"-28"	PD-PM	Su,Ps	DS	
Panicum perlongum	Long-stalked panic grass			8"-20"	PD-PDM	Su	DS	
Panicum praecocius	Early panic grass			8"-20"	PD-PM	Su	DS	
Panicum virgatum	Switch grass			3'-6'	PD-PW	Su,Ps	DS	Aggressive
Parnassia glauca	Grass-of-parnassus	Aug-Oct	Wht/Grn	8"-16"	PWM-PW,	Su		
Parthenium integrifolium*	Wild quinine	Jul-Sep	Wht	20"-40"	PDM-PM	Su,Ps	WS(30-60)	

WISCONSIN PRAIRIE SPECIES LIST

Scientific Name	Common Name	Bloom	Color	Height	Habitat	Light	Germination Tmt	Comments
Pedicularis canadensis	Wood betony	Apr-Jun	Yel	4"-16"	PD-PW	Ps,Su	WS(30)	Parasitic
Pedicularis lanceolata	Swamp betony	Aug-Sep	Yel	1'-3'	PWM-PW,	Ps,Su	WS(30)	Parasitic
Penstemon digitalis	Foxglove beardtongue	May-Jul	Wht	2'-5'	PDM-PM	Su,Ps	WS(60)-ES or Fa	
Penstemon gracilis	Slender beardtongue	Jun-Jul	Lav	8"-24"	PDM	Su,Ps	WS(60)-ES or Fa	
Penstemon grandiflorus	Beardtongue	May-Jun	Lav	12"-40"	PD-PDM	Su	WS(60)-ES or Fa	
Penstemon hirsutus	Hairy beardtongue	May-Jul	Lav	16-32"	PDM	Ps,Su	WS(60)-ES or Fa	
Petalostemum candidum	White prairie clover	Jun-Jul	Wht	1'-3'	PD-PWM	Su	WS(30),Sc,In	
Petalostemum purpureum	Purple prairie clover	Jun-Aug	Pur	1'-3'	PD-PWM	Su	WS(30),Sc,In	
Phlox glaberrima	Smooth phlox	Jun-Jul	Pnk	20"-48"	PDM	Ps,Su	WS(90) or Fr	
Phlox pilosa	Downy phlox	Apr-Jun	Pnk	6"-24"	PDM-PW	Su,Ps	WS(90) or Fr	
Physalis heterophylla	Clammy ground cherry	Jun-Sep	Yel/Brn	8"-36"	PD-PWM	Ps,Su		
Physalis subglabrata	Tall ground cherry	Jul-Aug	Yel	16"-32"	PD-PDM	Su,Ps		
Physalis virginiana	Lance-leaved ground cherry	Jul-Aug	Yel	1'-2'	PD-PWM	Su,Ps		
Physostegia virginiana	False dragonhead	Aug-Oct	Pnk	2'-3'	PD-PWM	Su, Ps	WS(60-90)	
Plantago rugelii	Red-stalked plantain	Jun-Aug	Grn	3"-12"	PDM	Su	WS(60-90)	Disturbed gnd, weedy
Platanthera flava*	Tubercled orchid	Jun-Sep	Crm	12"-28"	PWM-PW	Su, Ps	Difficult	
Platanthera leucophaea*	White fringed orchid	Jun-Jul	Wht	16"=40"	PWM-PW	Su	Difficult	
Polemonium reptans	Jacob's ladder	May-Jun	Blu	8"-16"	PWM-PW	Sh,Ps,Su	WS(60-90)-ES	
Polygala polygama	Purple milkwort	Jun-Aug	Ros	4"-10"	PD-PDM	Su	WS(30-60)	Biennial
Polygala sanguinea	Field milkwort	Jul-Sep	Ros	4"-16"	PDM-PWM	Su,Ps		
Polygala senega	Seneca snakeroot	May-Jul	Wht-Crm	4"-20"	PDM-PW,C	Ps,Su		
Polygala verticillata	Whorled milkwort	Jul-Oct	Crm-Grn	2"-16"	PDM	Su,Ps		Annual
Polygonatum canaliculatum	Smooth solomon's seal	May-Jul	Grn	1'-4'	PD-PWM	Ps,Su	WS/WWS/WS	Rh
Polygonum amphibium	Water knotweed	Jun-Aug	Pnk	1'-5'	PWM-PW	Su		
Polygonum tenue	Slender knotweed	Jun-Oct	Pnk	4"-16"	PD-PDM	Su		Annual
Polytaenia nuttallii*	Prairie parsley	May-Jun	Yel	20"-40"	PM-PWM	Su	WS(120) or Fa	
Potentilla arguta	Prairie cinquefoil	Jun-Jul	Yel	12"-40"	PD-PWM	Su,Ps	WS(30)-ES or Fa	Rh
Potentilla simplex	Common cinquefoil	Apr-Jun	Yel	2"-8"	PM-PWM	Su,Ps		Rh
Prenanthes alba	Lion's foot	Aug-Sep	Wht	1.5'-5'	PM-PWM	Sh,Ps	WS(30-60)	
Prenanthes aspera*	Rough white lettuce	Aug-Sep	Wht	2'-5'	PDM-PWM	Su		
Prenanthes crepidinea*	Great white lettuce	Aug-Sep	Crm	3'-7.5'	PWM	Sh,Ps,Su		
Prenanthes racemosa	Rattlesnake root	Sug-Sep	Lav	1'-5'	PDM-PW	Su	WS(120) or Fa	
Psoralea argophylla	Silvery scurfy pea	Jun-Aug	Blu	1'-2'	PM	Su		
Psoralea esculenta	Pomme-de-prairie	May-Jul	Blu	4"-16"	PD	Su	WS(60),In,Sc	
Pteridium aquilinum	Braken fern			2'-5'	PDM-PW	Ps,Su	Spores	Fern, Rh

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WISCONSIN PRAIRIE SPECIES LIST

Scientific Name	Common Name	Bloom	Color	Height	Habitat	Light	Germination Tmt	Comments
Pycnanthemum virginianum	Common mountain mint	Jul-Sep	Wht	2'-3'	PM-PW	Su,Ps	WS(30-60)	
Ranunculus fascicularis	Early buttercup	Apr-May	Yel	4"-8"	PM-PWM	Su,Ps	WS(30)-Wa or Fr	SL-Per
Ranunculus rhomboideus	Prairie buttercup	Apr-May	Yel	4"-8"	PDM	Ps,Su	WS(30)-Wa or Fr	
Ranunculus septentrionalis	Swamp buttercup	May-Jun	Yel	5"-10"	PWM-PW	Sh,Ps,Su		
Ratibida pinnata	Yellow coneflower	Jul-Sep	Yel	2'-4'	PD-PW	Su,Ps,Sh	WS(30-60)	
Rhus radicans	Poison ivy	May-Jun	Crm	4"-36"	PD-PW	Sh,Ps,Su		Vine, weedy
Rosa spp.	Wild rose	Jun-Aug	Ros	1'-3'	PD-PW	Sh,Ps,Su	WS(120),Sc orFa	
Rudbeckia hirta	Black-eyed susan	Jun-Aug	Yel/Brn	1'-3'	PD-PW	Su,Ps	DS or WS(30)	Biennial,SL-Per
Rudbeckia laciniata	Tall coneflower	Jul-Sep	Yel	2'-10'	PWM-PW	Su,Ps	WS(30-60)	
Rudbeckia subtomentosa	Sweet black-eyed susan	Jul-Oct	Yel	2'-6'	PWM-PW	Su,Ps	WS(30)	
Rumex verticillatus	Swamp dock	Jun-Aug	Grn	1'-4'	PWM	Su		Disturbed gnd, weedy
Sanicula marilandica	Black snakeroot	Jun-Aug	Grn/Wht	1'-3'	PM-PW	Sh	WS(30-60)	
Saxifraga pensylvanica	Swamp saxifrage	May-Jun	Grn	12"-40"	PWM-PW	Su		
Schizachrium scoparius	Little bluestem	Aug-Sep		2'-3'	PD-PWM	Su	DS	
Scleria tirgomerata	Tall nut-rush			3'	PDM,PM,P	Ps,Su		Rh
Scrophularia lanceolata	Early figwort	May-Jul	Red/Brn	2'-6'	PDM-PWM	Ps,Su	WS(30-60)	
Scutellaria galericulata	Marsh skullcap	Jun-Aug	Blu	8"-32"	PWM	Su		Rh
Scutellaria leonardi	Small skullcap	May-Jul	Blu	4"-8"	PD-PWM	Ps,Su		
Selaginella rupestris	Rock spikemoss			1"-2"	PD-PDM	Su,Ps		
Senecio aureus	Golden ragwort	May-Aug	Yel	6"-36"	PWM-PW	Sh,Ps,Su		
Senecio pauperculus	Balsam ragwort	May-Aug	Yel	4"-24"	PDM	Su		
Silene antirrhina	Sleep catchfly	Jun-Sep	Wht-Pnk	8"-32"	PD-PDM	Su	Fr or WS(60)-Lt	Annual
Silene stellata	Starry campion	Jun-Aug	Wht	12"-32"	PDM-PWM	Ps,Su		
Silphium integrifolium	Rosinweed	Jul-Sep	Yel	2'-6'	PDM-PW	Su	WS(30-60)	
Silphium laciniatum	Compassplant	Jul-Sep	Yel	3'-7'	PD-PWM	Su	WS(30-60)	
Silphium perfoliatum	Cupplant	Jul-Sep	Yel	3'-8'	PD-PW	Su	WS(30-60)	
Silphium terebinthinaceum	Prairie dock	Jul-Sep	Yel	2'-10'	PM-PW	Su	WS(30-60)	
Sisyrinchium campestre	Prairie blue-eyed grass	May-Jul	Blu-Wht	4"-16"	PD-PW	Su,Ps	WS(90)-ES or Fr	
Sium suave	Water parsnip	Jul-Sep	Wht	2'-6'	PM-PWM	Su		
Smilacina racemosa	False solomon's seal	May-Jun	Wht	16"-32"	PDM-PWM	Ps,Sh	WS/WWS/WS	
Smilacina stellata	Starry false solomon seal	May-Jun	Wht	8"-24"	PDM-PW	Su,Ps,Sh	WS/WWS/WS	
Smilax herbacea	Carrion flower	May-Jun	Yel	3'-7'	PM-PW	Sh,Ps		Climbing vine
Solidago canadensis	Common goldenrod	Jul-Oct	Yel	1'-7'	PDM-PW	Su,Ps		Rh, aggressive
Solidago gigantea	Late goldenrod	Jul-Oct	Yel	1'-7'	PWM-PW	Su,Ps		Rh, aggressive
Solidago graminifolia	Grass-leaved goldenrod	Jul-Oct	Yel	1'-4'	PM-PW	Su		Rh

WISCONSIN PRAIRIE SPECIES LIST

Scientific Name	Common Name	Bloom	Color	Height	Habitat	Light	Germination Tmt	Comments
Solidago juncea	Early goldenrod	Jul-Aug	Yel	1'-4'	PDM-PWM	Su	WS(60)-ES or Fa	
Solidago missouriensis	Missouri goldenrod	Jul-Aug	Yel	12"-40"	PD-PWM	Su,Ps	WS(60)-ES or Fa	Rh
Solidago nemoralis	Old-field goldenrod	Aug-Oct	Yel	4"-40"	PD-PWM	Su	WS(60)-ES or Fa	
Solidago ohiensis	Ohio goldenrod	Jul-Oct	Yel	16"-36"	PW	Su		
Solidago riddellii	Riddell's goldenrod	Aug-Oct	Yel	16"-40"	PWM-PW,	Su		
Solidago rigida	Stiff goldenrod	Jul-Oct	Yel	1'-5'	PD-PW	Su	WS(60)-ES or Fa	
Solidago speciosa	Showy goldenrod	Aug-Oct	Yel	1'-5'	PD-PWM	Su	WS(60)-ES or Fa	
Sorghastrum nutans	Indian grass			3'-7'	PD-PW	Su	DS	
Spartina pectinata	Prairie cordgrass			3'-7'	PM-PW	Su	DS	Rh
Spiranthes cernua	Nodding ladies' tresses	Aug-Sep	Wht	8"-40"	PM-PW	Ps,Su		
Sporobolus asper	Rough dropseed			1'-4'	PD-PM	Su		
Sporobolus cryptandrus	Sand dropseed			1'-3'	PD-PDM	Su	DS	
Sporobolus heterolepis	Prairie dropseed			16"-40"	PD-PWM	Su	DS-ES	
Sporobolus vaginiflorus	Sheathed rush grass				PD-PDM	Su		Annual
Stachys palustrus	Woundwort	Jun-Aug	Lav	12"-40"	PWM-PW	Su,Ps		Rh
Stipa spartea	Needle grass			2'-4'	PD-PWM	Su	Fr	
Taenidia integerrima	Yellow pimpernel	May-Jun	Yel	16"-32"	PM-PWM	Ps		
Tephrosia virginiana	Goat's rue	Jun-Jul	Pnk/Yel	8"-28"	PD-PM	Su,Ps,Sh	WS(30),Sc,In	
Teuricrium canadense	Germander	Jun-Aug	Pnk-Pur	12"-40"	PDM-PWM	Ps,Su		Rh
Thalictrum dasycarpum	Purple meadow rue	Jun-Jul	Crm	3'-4'	PM-PW	Su,Ps	WS(30-60)-ES	
Thaspium trifoliatum	Meadow parsnip	May-Jun	Pur	12"-32"	PM-PWM	Su,Ps	WS(120)-ES orFa	
Thelypteris palustrus	Marsh fern			14"-28"	PWM-PW	Sh,Ps,Su	Spores	Fern, Rh
Tofieldia glutinosa*	False asphodel	Jul	Wht	4"-8"	PW	Su		
Tradescantia ohiensis	Spiderwort	Jun-Jul	Blu	16"-40"	PD-PW	Su,Ps	WS(90)-ES or Fa	
Triodanis perfoliata	Venus looking glass	May-Aug	Blu	4"-40"	PDM-PD	Su,Ps		Annual
Triosteum perfoliatum	Late horse gentian	May-Jun	Grn-Yel	2'-4'	PDM, PWM	Sh,Ps		
Valeriana edulis ciliata	Valerian	May-Jun	Wht	1'-4'	PM-PW,Ca	Su	Fa	
Verbena hastata	Blue vervain	Jul-Oct	Blu	16"-40"	PWM	Su	WS(30)-Lt	SL-Per
Verbena stricta	Hoary vervain	Jul-Sep	Blu	8"-36"	PD-PDM	Su	DS or WS(30)	SL-Per
Vernonia fasciculata	Ironweed	Jul-Sep	Pur	2'-6'	PWM	Su,Ps	WS(30-60)	
Veronicastrum virginicum	Culver's root	Jun-Aug	Wht	3'-6'	PM-PW	Su,Ps	WS(30-60)-Lt	
Vicia americana	American vetch	Jun-Aug	Pur	to 3'	PM-PW	Ps,Su		Climbing vine
Viola cucullata	Hooded violet	Apr-Jul	Blu-Vlt	3"-6"	PM-PW	Su,Ps		Rh
Viola palmata	Palm-leaved violet	Apr-Jul	Vlt	6"-12"	PM	Su,Ps	WS(10-30) or Fa	Rh
Viola pedata	Bird's foot violet	Apr-Jul	Vlt	3"-6"	PD-PDM	Su,Ps	WS(10-30) or Fa	

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WISCONSIN PRAIRIE SPECIES LIST

Scientific Name	Common Name	Bloom	Color	Height	Habitat	Light	Germination Tmt	Comments
Viola pedatifida	Prairie violet	Apr-Jul	Vlt	4"-8"	PD-PM	Su	WS(30-60) or Fa	
Viola sagittata	Arrow-leaved violet	May-Jun	Vlt	2"-5"	PDM-PWM	Su,Ps	WS(10-30) or Fa	
Zigadenus elegans	White camass	Jun-Sep	Wht	1'-3'	PD-PWM,C	Su		
Zizia aptera	Heart-lvd Gold alexander	May-Jun	Yel	1'-3'	PDM-PWM	Su,Ps	WS(120) or Fa	
Zizia aurea	Golden alexander	May-Jun	Yel	1'-3'	PM-PW	Su,Ps,Sh	WS(120) or Fa	

Oak Savanna Groundlayer Species List

(The explanation of codes is on the last page.)

OAK SAVANNA GROUNDLAYER RESTORATION SPECIES LIST

(Nomenclature after Gleason & Cronquist, 2d ed., 1991)

Scientific Name	Common Name	Light			Soil		Bloom	Germ Treatment**	Notes
		Sh	Ps	Su	Me	Sa			
Achillea millefolium	Yarrow			x	x	x	June-Nov	DS, WS(30)	
Actea pachypoda	White baneberry	x			x		May-June		
Adiantum pedatum	Maidenhair fern	x			x				
Agastache nepetoides*	Yellow giant hyssop						Aug-Sept		
Agastache scrophulariaefolia	Purple giant hyssop				x		Aug-Sept		
Agrimonia gryposepala	Tall agrimony						July-Aug		
Agropyron trachycaulum	Slender wheat grass					x		DS	
Agrostis perennans	Upland bent grass		x		x	x			
Allium cernuum	Nodding wild onion			x	x	x	July-Aug.	WS(30-60) or Fr	
Ambrosia psilostachya	Sand ragweed			x		x	July-Oct	None	
Amorpha canescens	Leadplant		x	x	x	x	6/26-8/17	WS(30-60),In,Sc	
Amphicarpa bracteata	Hog peanut		x				Aug-Sept		
Andropogon gerardi	Big bluestem			x	x	x	7/21-9/16	DS	
Schizachrium scoparius	Little bluestem				x	x	Aug-Sept	DS	A. scoparius
Anemone cylindrica	Thimbleweed	x	x	x		x	5/23-7/16	WS(60-90)-ES,Fa	
Anemone patens	Pasqueflower			x		x	3/29-4/23	WS(60-90)-ES,Fa	
Anemone quinquefolia	Windflower		x		x	x	Apr-June	WS(60-90)-Wa	
Anemone virginiana	Tall anemone	x	x		x	x	June-Aug		
Anemonella thalictroides	Rue anemone		x		x		Apr-May	WWS(90)/WS(90)	
Antennaria neglecta	Pussytoes			x		x	3/31-5/16		
Apios americana	Ground nut	x					July-Aug.		
Apocynum androsaemifolium	Dogbane	x	x		x	x	6/14-8/14		
Apocynum cannabinum	Indian hemp			x	x		June-Aug.		
Aquilegia canadensis	Columbine	x	x		x	x	5/9-6/30	WS(30)	
Arabis canadensis	Sicklepod					x	May-July	Fr	
Arabis lyrata	Rock cress		x	x		x	May-July	Fr-Lt	
Aralia nudicaulis	Sarsaparilla	x	x		x		May-June		
Arctostaphylos uva-ursi	Bearberry			x		x	May-June		
Arenaria lateriflora	Grove sandwort				x		May-July	WS(30-60) or Fr	
Arisaema triphyllum	Jack in the pulpit	x			x		April-June	WS(60-90)	
Artemisia campestre caudata	Wormwood		x	x		x	July-Oct.		A. caudata
Asclepias amplexicaulis	Sand milkweed		x	x		x	6/11-7/25	WS(30-60)	
Asclepias exaltata	Poke milkweed	x	x		x		June-July	WS(30-60)	
Asclepias purpurascens*	Purple milkweed				x	x	June-July		
Asclepias syriaca	Milkweed			x	x	x	June-Aug.	WS(30)	
Asclepias tuberosa	Butterflyweed			x		x	7/9-8/21	WS(30-60)	
Asclepias verticillata	Whorled milkweed			x		x	July-Sept	WS(30)	
Asclepias viridiflora	Short green m.w.			x		x	7/1-7/25	WS(30-60)	
Aster azureus	Sky blue aster			x		x	8/23-10/31	WS(30-60)-ES	
Aster ericoides	Heath aster	x	x	x	x	x	Aug-Oct.	WS(30-60)-ES	
Aster laevis	Smooth aster	x	x		x	x	8/17-10/14	WS(30-60)-ES	
Aster lateriflorus	Calico aster		x		x	x	Aug-Oct	WS(60)-ES or Fa	
Aster linariifolius	Flax leaf aster		x	x		x	July-Oct	WS(60-90) or Fa	
Aster oblongifolius	Fall aster			x		x	Sept. Oct.	WS(30-60) or Fa	
Aster sagittifolius	Arrow leaf aster	x	x		x	x	Aug-Oct	WS(60)-ES or Fa	
Aster sericeus	Silky aster			x		x	Aug-Oct	WS(60)-ES or Fa	

Scientific Name	Common Name	Light			Soil		Bloom	Germ Treatment	Notes
		Sh	Ps	Su	Me	Sa			
Aster shortii	Short's aster				x		Aug-Oct	WS(60)-Es or Fa	
Astragalus canadensis	Milkvetch		x	x	x	x	July-Aug.	WS(60),Sc,In	
Athyrium filix-femina	Lady fern	x			x				
Aureolaria flava	Smooth false foxglove	x	x		x	x	July-Sept		
Aureolaria grandiflora	Y. false foxglove		x			x	8/2-9/8		
Aureolaria pedicularia	Annual false foxglove		x		x		Aug-Sept		
Baptisia lactea	White false indigo			x	x		June-July	WS(90),Sc,In	B. leucantha
Baptisia bracteata	Cream wild indigo		X		x	x	May-June	WS(90),Sc,In	B. leucophaea
Bessya bullii*	Kittentails			x		x	May	WS(120) or Fa	
Blephilia ciliata	Blephilia		x	x	x		June-Aug	WS(30-60)	
Botrychium dissectum	Grape fern		x		x				
Botrychium virginianum	Rattlesnake fern	x			x				
Bouteloua curtipendula	Side oats grama		x	x		x		DS	
Bouteloua hirsuta	Mustache grass			x		x		DS	
Brachyelytrum erectum	Long-awned wood grass	x	x		x			DS	
Bromus ciliatus					x			DS	
Bromus kalmii					x	x		DS	
Bromus pubescens			x		x			DS	B. purgans
Cacalia atriplicifolia	Pale indian plantain				x	x	July-Sept	WS(30-60)	
Campanula americana	Tall bellflower	x	x		x	x	July-Sept.	WS(30-60)-Lt	
Campanula rotundifolia	Harebell		x	x	x	x	June-Oct.	WS(30-60)-Lt	
Carex blanda			x		x				
Carex brevior						x			
Carex meadii						x			
Carex pennsylvanica	Pennsylvania sedge	x	x		x	x	4/1-5/30		
Chamaecrista fasciculata	Partridge pea	x	x			x	July-Aug	DS or WS(30),In	Cassia fasciculata
Castilleja sessiliflora	Downy painted cup			x		x	May-July		
Ceanothus americanus	New Jersey tea		x		x	x	6/27-8/8	H2O+WS(90)	
Ceanothus ovatus	Inland New Jersey tea	x	x			x	May-June	H2O+WS(90)	
Circaea lutetiana	Enchanter's nightshade	x			x	x	June-Aug.		C.quadrisulcata
Cirsium altissimum	Tall thistle				x		July-Oct	WS(30-60)	
Cirsium discolor	Field thistle			x	x		July-Oct	WS(30-60)	
Claytonia virginica	Spring beauty	x	x		x		May		
Clematis virginiana	Virgin's bower				x	x			
Comandra umbellata	False toadflax		x	x		x	5/9-7/3		C. richardsiani
Calystegia sepium	Hedge bindweed				x		May-Sept		Convolvulus s.
Calystegia spithamea	Low bindweed					x	May-July		Convolvulus s.
Coreopsis palmata	Prairie coreopsis	x	x	x	x	x	6/19-8/15	WS(30-60)	
Coreopsis tripteris	Tall coreopsis				x	x	July-Sept	WS(60)	
Cypripedium pubescens	Large yellow ladyslipper	x	x		x		May-June		
Danthonia spicata	Poverty oat grass					x		DS	
Desmodium canadense	Showy tick trefoil		x		x		7/12-9/4	WS(60),Sc,In	
Desmodium canescens	Hoary tick trefoil				x		July-Aug	WS(30-60),Sc,In	
Desmodium cuspidatum	Bracted tick trefoil					x	July-Aug	WS(30-60),In	
Desmodium glutinosum	Pointed tick trefoil	x	x		x	x	July-Aug	WS(30-60),In	
Desmodium illinoense	Illinois tick trefoil	x			x		July-Aug	WS(30-60),Sc,In	
Dioscorea villosa	Wild yam		x		x		June-July		

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Scientific Name	Common Name	Light			Soil		Bloom	Germ Treatment	Notes
		Sh	Ps	Su	Me	Sa			
Dodecatheon meadia	Shooting star	x	x		x	x	5/7-6/24	WS(60)-ES or Fa	
Draba reptans	Common whitlow cress				x		Apr-May	Fr-Lt	
Elymus canadensis	Canada wild rye			x	x	x		DS	
Elymus villosus	Silky wild rye	x	x		x	x		DS	
Elymus virginicus	Virginia wild rye				x			DS	
Eragrostis capillaris	Lace grass					x			
Erigeron pulchellus	Robin's fleabane		x			x	May-June	None	
Erigeron strigosus	Daisy fleabane		x	x	x	x	June-Sept.	None	
Eryngium yuccifolium	Rattlesnake master		x	x	x	x	July-Aug.	WS(30-60)	
Eupatorium altissimum	Tall boneset			x	x		July-Oct.	WS(30-60)-Lt	
Eupatorium purpureum	Joe Pye weed				x		July-Sept	WS(30-60)-Lt	
Eupatorium sessilifolium	Upland boneset				x		Aug-Sept	WS(30-60)-Lt	
Euphorbia corollata	Flowering spurge	x	x	x	x	x	6/1-8/21	WS(30-60)	
Festuca obtusa	Nodding fescue	x			x			DS	
Fragaria virginiana	Wild strawberry	x	x		x	x	4/14-6/15	None	
Galium boreale	Bedstraw		x		x	x	6/7-7/23		
Galium concinnum	Shining bedstraw				x	x	June-Aug		
Galium triflorum	Sweet scented bedstraw		x		x		June-Aug		
Gentiana flavida*	Cream gentian		x		x		Sept-Oct	WS(30-60)-Wa-Lt	G. alba
Gentiana puberulenta	Downy Gentian		x	x		x	Aug.-Oct.	WS(30-60)-Wa-Lt	G. puberula
Gentianella quinquefolia	Stiff gentian		x			x	Aug-Sept	WS(60-90)-Wa-Lt	Gentiana q.
Geranium maculatum	Wild geranium	x	x		x	x	5/2-6/22	WS(60-90),Sc	
Geum canadense	White avens	x			x	x	May-June		
Geum triflorum	Prairie smoke		x	x		x	4/25-6/14	WS(60)-ES or Fa	
Gnaphalium obtusifolium	Sweet everlasting					x	July-Oct	WS(30-60)	
Hedeoma hispida	Grassleaf pennyroyal			x		x	May-Aug.		
Helianthemum canadense	Frostweed	x	x			x	5/27-7/22	WS(90)-Lt	
Helianthus decapetalus	Pale sunflower				x		Aug-Oct	WS(30)	
Helianthus hirsutus	Oblong sunflower		x	x		x	July-Oct	WS(30)	
Helianthus laetiflorus	Prairie sunflower			x	x	x	Aug-Sept	WS(30)	
Helianthus occidentalis	Western sunflower			x	x	x	7/21-9/9	WS(30)	
Helianthus strumosus	Woodland sunflower	x	x		x	x	July-Sept	WS(30)	
Heliopsis helianthoides	Ox-eye sunflower		x		x		July-Sept	WS(30)	
Hepatica americana		x			x		April	WWS(90)/WS(90)	
Heuchera richardsonii	Alum root		x	x	x	x	June-July	WS(90)-Lt or Fa	
Hieracium kalmii	Canada hawkweed		x	x	x	x	July-Oct.	WS(30-60)	H. canadense
Hieracium longipilum	Long bearded hawkweed			x		x	7/5-9/7	WS(30-60)	
Hypericum punctatum	Spotted St. John'swort				x	x	June-Aug		
Hypoxis hirsuta	Yellow star grass		x	x	x	x	April-July	WS(60-90) or Fr	
Elymus hystrix	Bottlebrush grass	x	x		x	x		DS	Hystrix patula
Koeleria cristata	June grass			x		x	May-June	DS	
Krigia biflora	False dandelion		x			x	5/9-7/13		
Kuhnia eupatorioides	False boneset			x	x	x	Aug.-Oct.	WS(30-60) or Fr	
Lactuca biennis	Tall blue lettuce	x	x		x		July-Sept		
Lactuca canadensis	Wild lettuce				x		July-Sept		
Lactuca ludoviciana	Wild lettuce			x	x		July-Sept.		
Lathyrus ochroleucus	Pale vetchling				x	x	May-July		

Scientific Name	Common Name	Light			Soil		Bloom	Germ Treatment	Notes
		Sh	Pa	Su	Me	Sa			
Lathyrus venosus	Veiny pea		x		x		June-July	WS(30),Sc,In	
Lechea intermedia	Middling pinweed					x			
Lechea tenuifolia	Pinweed		x	x		x	July-Sept.		
Leersia virginica	White grass	x			x			DS	
Lespedeza capitata	Roundheaded bush clover		x	x	x	x	7/30-9/6	WS(60),Sc,In	
Lespedeza violacea*	Violet bush clover					x			
Liatris aspera	Rough blazing star			x	x	x	Aug-Oct	WS(30-60)	
Liatris cylindracea	Dwarf blazing star			x		x	July-Sept.	WS(30-60)	
Liatris ligulistylis	Blazingstar		x		x			WS(30-60)	
Liatris pychnostachya	Gayfeather			x	x		July-Sept.	WS(30-60)	
Lilium superbum	Turk's cap lily				x		July-Aug	WWS(90)/WS(90)	L. michiganense
Lilium philadelphicum	Wood lily		x		x	x		WWS(90)/WS(90)	
Linum sulcatum	Yellow flax		x	x		x	June-July	DS or WS(30)	
Liparis lilifolia	Twayblade	x	x		x		June-July		
Lithospermum canescens	Hoary puccoon			x		x	4/20-6/6	Fr orWS(120),Sc	
Lithospermum caroliniense	Puccoon		x	x		x	May-July	Fr orWS(120),Sc	
Lithospermum incisum	Gromwell			x		x	May-June		
Lobelia spicata	Pale spiked lobelia		x	x		x	6/7-7/28	WS(30-60)-Lt	
Lupinus perennis occidentalis	Lupine		x			x	5/12-6/28	WS(30),In or Fr	
Luzula multiflora	Common wood rush	x			x	x			
Lysimachia lanceolata	Lanceleaf loosestrife		x	x		x	June-July		
Lysimachia quadriflora	Prairie loosestrife			x	x		July-Aug.	WS(30-60)	
Lysimachia quadrifolia	4-leaf loosestrife	x	x		x	x	June-July		
Melica nitens*	Tall melic grass					x			
Monarda fistulosa	Bee balm	x	x	x	x	x	7/1-8/31	WS(30)	
Monarda punctata	Dotted mint			x		x	July-Sept.	DS or WS(30)	
Muhlenbergia cuspidata	Prairie satin grass			x		x		DS	
Muhlenbergia racemosa	Upland wild timothy			x		x		DS	
Oenothera biennis	Evening primrose			x	x	x	July-Oct.	Fa or WS(30)	
Oenothera perennis	Small sundrops		x	x		x	May-July		
Orobanche uniflora*	One flowered broom rape				x	x			
Oryzopsis racemosa	Black rice grass	x			x	x		DS	
Osmorhiza claytonii	Sweet cicely	x	x		x	x	May-June	WWS(90)/WS(90)	
Osmorhiza longistylis	Anise root	x	x		x		June-Aug	WWS(90)/WS(90)	
Osmunda claytonia	Interrupted fern	x			x				
Oxalis violacea	Violet wood sorrel		x	x		x	4/30-6/16		
P.oligosanthes scribnerianum	Scribner's panic grass		x	x		x	5/22-7/3	DS	
Panicum lanuginosum implicatum			x		x	x		DS	P. implicatum
Panicum latifolium	Broad leavedpanic grass	x			x	x		DS	
Panicum leibergii	Prairie panic grass		x	x	x			DS	
Panicum villosissimum	Early panic grass					x		DS	P. praecocius
Pedicularis canadensis	Wood betony	x	x	x		x	5/2-5/20	WS(30)	
Penstemon digitalis	Foxglove beardtongue				x	x		WS(30-60)	
Penstemon gracilis	Slender beardtongue					x	5/23-7/5	WS(60)-ES or Fa	
Penstemon grandiflorus	Large flowered beardtong					x	May-June	WS(60)-ES or Fa	
Penstemon hirsutus	Hairy beardtongue		x	x		x	June-July	WS(60)-ES or Fa	
Penstemon pallidus	Pale beardtongue					x		WS(60)-ES or Fa	

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Scientific Name	Common Name	Light			Soil		Bloom	Germ Treatment	Notes
		Sh	Ps	Su	Me	Sa			
Dalea candidum	White prairie clover			x	x	x	7/1-8/24	WS(30-60),Sc,In	Petalostemum c.
Dalea purpureum	Purple prairie clover			x	x	x	7/1-8/27	WS(30-60),Sc,In	Petalostemum p.
Phlox glaberrima*	Smooth phlox				x		June-Aug.	WS(90) or Fr	
Phlox pilosa	Prairie phlox		x	x		x	5/2-7/16	WS(90) or Fr	
Phryma leptostachya	Lopseed	x			x		July-Aug.		
Physalis heterophylla	Clammy ground cherry		x	x		x	June-Sept.		
Physalis virginiana	Lanceleaf ground cherry		x	x		x	6/9-7/11		
Podophyllum peltatum	Mayapple	x	x		x		May	WS(30-60)	
Polemonium reptans	Jacob's ladder				x		4/14-5/31	WS(60)	
Polygala polygama	Sand milkwort			x		x	June-Aug.	WS(30-60)	
Polygala sanguinea	Red milkwort		x	x		x	July-Sept.		
Polygala senega	Seneca snakeroot		x	x		x	May-July		
Polygala verticillata	Milkwort		x	x	x	x	July-Oct.		
Polygonatum biflorum	Solomon's seal		x	x	x	x	5/26-6/28	WS/WWS/WS	P. canniculatum
Polygonatum pubescens	Downy Solomon's seal	x			x			WS/WWS/WS	
Potentilla arguta	Prairie cinquefoil			x		x	June-July	WS(30)-ES or Fa	
Potentilla simplex	Common cinquefoil	x	x	x	x	x	5/23-6/25		
Prenanthes alba	Lion's foot	x	x		x	x	Aug.- Oct.	WS(30-60)	
Pteridium aquilinum	Bracken fern		x	x		x			
Pycnanthemum virginianum	Mountain mint		x	x	x		July-Sept.	WS(30-60)	
Pyrola elliptica	Large leaved shinleaf	x				x	June-Aug.		
Ranunculus abortivus	Aborted buttercup	x	x		x	x	April-June	WS(30-60)-Wa	
Ranunculus fascicularis	Early buttercup		x	x	x	x	4/20-5/24	WS(30)-Wa or Fr	
Ranunculus rhomboideus	Prairie buttercup	x	x			x	April-May	WS(30)-Wa or Fr	
Ratibida pinnata	Yellow coneflower	x	x	x	x	x	7/5-9/7	WS(30-60)	
Rosa sp.		x	x	x	x	x	June-July	WS(120),Sc orFa	
Rudbeckia hirta	Black-eyed susan		x	x	x	x	6/5-8/27	DS or WS(30)	
Rudbeckia subtomentosa	Sweet black-eyed susan		x	x	x		July-Oct.	WS(30)	
Rudbeckia triloba	Brown-eyed susan			x	x			WS(30-60)	
Sanicula marilandica	Black snakeroot	x			x		July-Aug.	WS(30-60)	
Scrophularia lanceolata	Early figwort				x	x		WS(30-60)	
Scrophularia marilandica	Late figwort	x	x		x	x	May-Aug.		
Scutellaria parvula	Small skullcap			x		x	June-July	WS(60-90) or Fr	
Silene antirrhina	Sleepy catchfly			x		x	June-Sept.	WS(30-60)-Lt	
Silene stellata	Starry campion				x	x	June-July		
Silphium integrifolium	Rosin weed			x	x	x	July-Sept.	WS(30-60)	
Silphium laciniatum	Compass plant			x	x	x	7/9-9/16	WS(30-60)	
Silphium terebinthinaceum	Prairie dock			x	x		July-Sept.	WS(30-60)	
Sisyrinchium campestre	Blue-eyed grass		x	x		x	5/9-7/6	WS(90)-ES or Fr	
Smilacina racemosa	Solomon's plume	x	x		x	x	4/30-6/10	WS/WWS/WS	
Smilacina stellata	Starry solomon's plume	x	x	x	x	x	4/30-5/30	WS/WWS/WS	
Smilax ecirrhata	Low carrion flower	x			x		May-June		
Smilax herbacea	Carrion flower	x			x				
Smilax herbacea lasioneura	Carrion flower				x				S. lasioneura
Solidago flexicaulis	Zig zag goldenrod	x			x		Aug.-Sept.	WS(60)-ES or Fa	
Solidago juncea	Early goldenrod			x		x	July-Aug.	WS(60)-ES or Fa	
Solidago missouriensis	Missouri goldenrod			x	x		July-Aug	WS(60)-ES or Fa	

Scientific Name	Common Name	Light			Soil		Bloom	Germ Treatment	Notes
		Sh	Ps	Su	Me	Sa			
Solidago nemoralis	Dyer's weed				x	x	Aug.-Oct.	WS(60)-ES or Fa	
Solidago rigida	Stiff goldenrod			x	x	x	8/14-9/27	WS(60)-ES or Fa	
Solidago speciosa	Showy goldenrod			x	x	x	Aug.-Oct.	WS(60)-ES or Fa	
Solidago ulmifolia	Elm-leaf goldenrod	x	x		x	x	July-Oct.	WS(60)-ES or Fa	
Sorghastrum nutans	Indian grass			x	x	x	8/10-9/22	DS	
Sphenopholis obtusata	Prairie wedge grass		x	x		x		DS	
Sporobolis heterolepis	Prairie dropseed		x	x	x	x		DS-ES	
Sporobolus cryptandrus	Sand dropseed		x	x		x		DS	
Stipa avenacea	Black oat grass	x	x		x	x	May-June		W.side L. Mich
Stipa spartea	Needle grass			x	x	x		DS-ES or Fa	
Frasera caroliniensis	Columbo		x	x	x		May-June		Swertia c.
Symphoricarpos occidentalis	Wolfberry				x				
Taenidia integerrima	Yellow pimpernel		x		x	x	May-June		
Tephrosia virginiana	Goat's rue	x	x	x		x	June-July	WS(30-60),Sc,In	
Teucrium canadense	Germander, Wood sage	x							
Thaspium trifoliatum*	Meadow parsnip			x	x			WS(120)-ES orFa	
Agalinis auriculata			x	x	x		Aug.-Sept.		Tomanthera a.
Tradescantia ohiensis	Spiderwort		x	x	x	x	5/25-7/29	WS(90)-ES or Fa	
Triodanus perfoliata	Venus's looking glass		x	x		x	May-Aug.		
Triosteum aurantiacum	Early horse gentian		x		x				
Triosteum perfoliatum	Late horse gentian	x	x		x		May-June		
Uvularia grandiflora	Bellwort	x			x		April-May		
Verbena stricta	Hoary vervain			x	x	x	July-Sept.	DS or WS(30)	
Veronicastrum virginicum	Culver's root		x	x	x		6/29-8/23	WS(30-60)-Lt	
Vicia americana	American vetch		x	x	x				
Vicia caroliniana	Wood vetch	x	x		x	x	May-June		
Viola pedata	Bird's foot violet		x	x		x	4/11-6/21	WS(30)	
Viola palmata pedatifida	Prairie violet			x	x	x	April-May	WS(30-60) or Fa	V. pedatafida
Viola sororia	Hairy violet		x		x				
Zigadenus elegans	White camass		x		x	x	June-Sept		
Zizia aptera	Heart-lvd gldn alexander		x	x	x		May-June	WS(120) or Fa	
Zizia aurea	Golden alexanders	x	x	x	x		5/9-6/27	WS(120) or Fa	

Light
Sh = Shade
Ps = Partial shade
Su = Sun

Soil
Me = Mesic
Sa = sand

* Listed as Endangered or Threatened in Wisconsin.

** Germination Treatment Codes

Germination treatments are based on practical experience gained by propagating many of these species at commercial wildflower nurseries by Brian Bader and Alan Wade. Most of the information provided is not the result of controlled experiments. In the few cases where published information exists, this information was used.

WS = Wet Stratification. Mix seeds with moist sawdust, vermiculite or clean sand and store at 34° - 38° F.
WWS = Warm Wet Stratification. Mix seeds with moist sawdust, vermiculite or clean sand and store at 50° - 60° F.
DS = Dry Stratification. Store seeds in unheated shed or garage overwinter.
Sc = Scarification. Scratch seed coats.
In = Inoculate with rhizobium bacterium (applied to legumes).
Fr = Plant fresh seed.
Fa = Plant seed in fall.
-ES = Plant seed in early spring, seed germinates best with cool soil temperatures.
-Wa = Plant seed when soil temperatures are warm.
-Lt = Seed germination is improved with light, do not cover seeds, simply firmly press into soil.
( ) = Number of days for treatment.
H20 = Hot water treatment. Soak seed in boiling water for 1-2 minutes.

Examples:

WS(30-60) = Wet stratify seed for 30-60 days
WWS(90)/WS(90) = Warm wet stratify seed for 90 days followed by cold wet stratification for 90 days
WS(60)-ES = Wet stratify seed for 60 days and plant in early spring.
WS(30)-Wa = Wet stratify seed for 30 days and plant when soil temperatures are warm.
WS(30)-Lt = Wet stratify seed for 30 days, do not cover seed when planting
WS(30-60),In,Sc = Seed should be scarified and inoculated and wet stratified for 30-60 days.
H20+WS(90) = Soak seeds in hot water for 1-2 minutes followed by 90 days cold wet stratification.

Selected References on Seed Germination

Baskin, C.C. and J.M. Baskin. 1988. Germination Ecophysiology of Herbaceous Plant Species in a Temperate Region. American Journal of Botany. 75(2):286-305.

Deno, Norman C. 1991. Seed Germination Theory and Practice, 1st ed.

Parsons, Brian C., R.L. Gettig, J.A. McAnlis, D. Yates. 1992. Germination Requirements and Population Viability of Selected Monitored Rare Plant Species in Ohio. The Holden Arboretum.

Wade, Alan. 1993. Prairie Moon Nursery Catalog and Cultural Guide.

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PLANT PRODUCTION

and Seed Processing

The purpose of this section on plant production and seed handling is to familiarize you, the avid prairie reviver, with some methods and techniques for successful plant propagation. Seed harvesting, collection, treatment, storage, and germination are covered here. Container and nursery production for growing the plants to transplantable size to the restoration site are also included under this heading. While this section is neither all inclusive nor highly technical, it is hoped that the enthusiasm and interest of the supporters and caretakers of your restoration site provide you with the desire to explore the many aspects of prairie ecosystem revival.

Seed Harvesting

Timing

The goal is to collect seed at full maturity, and therefore, ensure the greatest percentage of viability. There are two stages of seed development: 1) the soft dough stage; and, 2) the hard dough stage. The seed is in the soft dough stage if, when squeezed between the thumb and forefinger, the seed interior is ejected as a doughy substance. Soft dough seed tends not to be viable. The hard dough stage is determined by the bite test. Simply put, if the seed is too hard to bite, it may be considered mature and has, in all probability, achieved dormancy. Dormancy is a condition of the seed in which germination is prevented by internal mechanisms. These mechanisms may be either physical or chemical in nature and help to protect the future seedling from germinating at a time which may be detrimental to its health.

Collection

There are specific guidelines in the collection of seed as regards to quantity. These guidelines were established to ensure the continuation of the established biosystem, and are as follows. Collect only 10% of those species which are uncommon or which depend solely on seed for reproduction (annuals and biennials). Most species may be harvested at a 25% rate and a few widespread and common species may be collected at 50% of the harvestable seed. However, it is never recommended to collect above the 50% rate.

If you collect in anything plastic, the container must remain open because the seed has not been dried, yet. You will want to collect seed in paper bags or plastic buckets (ice cream pails work great!). Be sure to drop a label into each container with plant name, date, and location of collection with indelible marker. As restoration ecologists, you will also find it helpful to record the weather conditions at the time of harvest.

Consideration of recent past and current weather conditions is amust because it is important that the collected seed dry quickly or be planted immediately. Morning dew and humid weather should be avoided during seed collection for most species. As always, there are exceptions to the rule. Spiderwort needs to be collected in the morning when the flowers are open and it is possible to determine which seedheads are ripe.

The variety of seedhead formations dictates different techniques of collection. Most prairie grasses and spiked flowerheads can be harvested by stripping the stalk by hand. Species with entire seedheads, such as goldenrod, gayfeather, asters and berries, should be harvested by pruning off the whole seedhead. Plants with loose seeds (columbine, monarda) can be harvested by simply shaking the seedhead into a bucket or bag. Lupine, phlox and violets - plants that form seed pods that pop open when mature - pose a bit more of a challenge. Two techniques may be employed here. The first would be for you to place a nylon or mesh bag over the pod prior to the popping of the pod. The second would be to pick the individual pod, prior to dispersal, and place in a well aerated box. When the pod ripens and pops open the seeds are neatly contained in the box. It is recommended that while requiring more time and effort, technique #1 be used because of the greater percentage of viable seed.

Drying

As mentioned earlier, it is important to dry the seed quickly, however, drying too quickly may reduce its viability. Low ambient relative humidity is essential. Elevated temperatures, not to exceed 95-100 degrees F., will shorten the drying process. Place small quantities of seed in lunch size paper bags and place in the sun, in the furnace room, or in the garage over winter. Larger seed should be placed in open containers to enhance air circulation and all seeds should be turned several times during the drying process. Using a fan will, of course, provide air circulation and enhance drying. Once the seeds are dry you should store them in a cool, dry location. Beware of insects, rodents and mold.

Seeds with fleshy fruits, such as the berries of Solomon's Seal, require special handling. The pulp must be removed before drying. One of the easiest ways is to wrap the blades of a blender with electrical tape and in a slurry of equal parts water and berries give short bursts at low speed. Once you have decanted the floating pulp, pour the seeds onto a screen to wash off the remaining debris. Let the seeds air dry for 48 hours before you store them.

Seed Processing

Once the seed has been dried, it is ready for processing. Processing includes two basic steps: 1) threshing - breaking the actual seed from its protective coating; 2) cleaning - separating the wheat from the chaff, so to speak.

Threshing

There are many techniques for threshing, it takes only a little imagination. One of the simplest ways is to rub the harvested material against a coarse screen with a gloved hand. Try rubbing the plant material between two ping pong paddles. Or, alternatively, you could cut open an inner tube, tie off one end, place the material to be threshed inside, then roll the tube under foot on the floor. For removal of seeds from pods, a rolling pin and a wooden tray may be effective. Or, gently rub the pods between two bricks. Mechanical threshing may be accomplished by employing a hammer mill. This method works particularly well on the hulled seeds of tick trefoil, bush clover, bee balm and black-eyed Susan.

Cleaning

The ideal is to get seed completely clean. While this ideal is not 100% attainable, don't worry, the seed will grow. Still, strive for the 100% clean because it will reduce the volume of material to be stored, it will make sowing the seed easier, and it will increase the likelihood of planting viable seed. Cleaning is accomplished by shaking the threshed material through progressively tighter meshed screens. Naturally, not all undesirable material will be sifted out, but there are various methods for removal of the dirt and smaller pieces of plant matter that remain. Since the viable seed is denser than the material that accompanies it through the final screening, it is a simple process to blow that material away. With this process, a little experimentation is in order. Place a fan (or perhaps a hair dryer) on a table, and winnow the chaff from the seed. The experimentation part of this technique is in finding the correct distance from the source of the wind at which to drop the seed. It is important to start at a greater distance and move closer as the seed gets cleaner. Of course, there is the danger of blowing the seed away, so, an ounce of caution is worth a pound of cure. Commercial seed producers and we at the arboretum use a contraption caled a fanning mill in the final stages of seed cleaning.

Seed Storage

Seed storage need not be a high tech procedure, however, there are some interesting known facts concerning the conditions of storage. The optimum seed moisture content should range between 5 and 14 % and, while it is very difficult for the layman to know the actual value that a given batch of seed contains in moisture, it is important to know that a reduction of just 1% in seed moisture doubles the storage life of the viable seed. Likewise, each 9 degree F. reduction in storage temperature also doubles the storage life of viable seed. The sum of the relative humidity and the temperature should not exceed 100. You must try to maintain relatively stable conditions for the stored seed. Wide and constant fluctuations in temperature and relative humidity have a negative impact on the storage life of seed.

Some ideas for storage containers for your dried seed include ice cream pails, coffee cans with plastic lids, yogurt containers, or heavy plastic bags. It is a good idea to place an indicator type desiccant in the container with the seed to maintain and monitor the

moisture content of the interior of the container. Indicator type desiccants change color, typically from blue to pink, when the relative humidity exceeds a certain value. These indicator dessicants are made of calcium sulfate (dessicant) impregnated with cobalt chloride (indicator) and are available from agri-industry retailers and wholesalers. If done properly, seed will maintain its viability for up to four years.

Seed treatment

It is important to think of the ecosystem from which your seeds have come when considering the type of treatment that is required for breaking dormancy. Dormancy provides a safety net for the seed to not germinate when habitat conditions are unfavorable to the survival of the seedlings. Seed treatment for breaking dormancy is used when propagating seed, and not when direct planting to the restoration site in the fall. There are four general treatments (and many variations) for breaking this dormancy: 1) cold, dry stratification; 2) wet stratification; 3) scarification; 4) other treatments. Please refer to the Wisconsin Prairie Species List for the specific treatment required.

Cold, dry stratification

Cold, dry stratification is exactly what it sounds like. The seed is stored in a dry condition while being exposed to native habitat temperature conditions - commonly called winter in Wisconsin. As you can imagine, most mezic to xeric prairie grass seeds are cold, dry stratified. Store the seed in any unheated building over winter, protected from rodents and insects.

Wet stratification

Wet stratification can be accomplished in many ways, but effective stratification requires the seed absorb moisture, the seed have adequate aeration, be exposed to the proper temperature, and have sufficient time to stratify. Wet stratification is easy to do using the same containers that the seed was stored in...ice cream pails, yogurt containers, etc. Moisten some sand, vermiculite or saw dust and mix with the seed at a 2:1 or 3:1 by volume ratio. The inert material should be "just" damp, not wringing wet. The potential for seed rot can be reduced by first sterilizing the inert material in a 400 degree oven for 1 hour, prior to wetting. After you have mixed the seed with the dampened material, return it to the moisture proof container, properly labeled on the side of the container (lids often get switched) and place in a refrigerator set to maintain 34 - 42 degrees. Seeds can also be planted directly into flats and placed in the refrigerator or other places where cool temperatures prevail. The length of time for wet stratification ranges from 1 to 4 months. Most species will germinate after 1 ½ months of stratification (some after 14 days!) but there is a higher percentage of germination after longer stratification periods.

A few species require multiple stratification treatments. The treatments may be a warm (68 -75 degrees) period followed by a cold (34 - 42 degrees) period, or a cold period followed by a warm period and then another cold period. It is common for spring ephemerals (here today, gone tomorrow flowers) and early bloomers to fall into this

category. Even rarer are some species which need a warm, wet stratification period. This process is identical to cold, wet stratification but uses warmer temperatures (68 - 75 degrees).

Scarification

Scarification is the process of "scarring" the seed coat (testa). Its purpose is to allow the seed within to imbibe water, and therefore, germinate. Different techniques of scarification are used depending on the permeability and thickness of the testa. More often than not, scarification is an easy process of scratching the seed coat by gently rubbing between two pieces of sandpaper. Mechanical scarifiers are available which consist of a sandpaper lined drum and rubber paddle wheels which force the seed to be scratched by the drum as the paddles turn within. You must check the seed to see if it is visibly scratched when using mechanical scarification for breaking seed coat dormancy.

Acid scarification is used for seeds with tough, thick seed coats. Many of these larger seeds are used as a food source for birds and other animals and acid scarification acts as a mimic of the conditions the seed encounters when passing through an animal's digestive tract. Complete procedures for acid scarification can be found in the book Plant Propagation by Hartmann and Kester, 5th Edition.

Another technique for getting the seed to imbibe water is soaking in boiling, or near boiling, water. This method apparently breaks down the waxy cuticle associated with some seed species.

If seed is planted to the field in the fall, the physical and biological processes encountered in the soil will also scarify the seed coat and allow germination to progress.

Other Treatments

Other treatments include heat, harvesting immature fruits, and application of plant growth regulators (hormones). Complete information on these methods can again be found in Plant Propagation by Hartmann and Kester.

Plant Propagation

Germination

Timing of when to begin germinating the seed is extremely important. To determine when to begin this process, see the section on timing of planting.

At the University of Wisconsin-Madison Arboretum, we germinate seed in flats filled with a soilless media - Sunshine #3 or Premier Germination mix are recommended. Because soilless media have little nutritive value, a slow - release fertilizer, such as Osmocote 14-14-14, should be thoroughly mixed into the medium prior to filling the flat. After filling the flat with the medium it should be completely moistened and then firmed with a board to eliminate air pockets. We recommend you do this the day before sowing the seed to ensure even saturation of the medium. Furrows should then be made on the

surface of the mix in which to plant the seed. Very fine seed can be sown on the surface of the media. After distributing the seed evenly in the rows, cover the seed to a depth approximately twice the diameter of the seed with fine grade vermiculite, saw dust, or soil media. Be sure to label the rows with plastic labels stating the plant species and date of sowing. A greenhouse is the best place to put the newly seeded flats because the environmental conditions can be better controlled. Other options would include a classroom with well controlled temperature conditions and grow lights (this is terrific for maintaining student interest), uncovered cold frames, or cold frames with a shade cover.

Plant production

There are three basic methods for propagating the plants which are to be planted to the field later: 1) containers kept in a greenhouse, shade house or coldframe; 2) nursery production (and subsequent barerooting to the field; 3) asexual propagation. *Container* propagation is useful for some of the prairie grasses (dropseed, side oats grama, bottlebrush grass), for seed where little is available, and for seed which is light and may blow away if planted outdoors. *Nursery* production is useful for those plants which will germinate in one season, most perennial forbs, and plants with coarse root systems (taproots, rhizomes, tubers, etc.) Since you will be digging up these plants to a bareroot condition, consideration must be given to the soil type of the designated nursery site. Sandy to sandy loams are ideal since the soil will fall away with little damage to the root system. It is too difficult to dig plants from silt loam to clayey soils without doing extensive damage to the root system. *Asexual* propagation is employed with plants that have rhizomes, bulbs, and species which are difficult to germinate because seed dormancy breaking requirements are unknown.

Container production

Several different types of containers are used in container propagation depending on the stage of growth of the seedlings. Once germinated and after having grown the first true leaves, the seedlings are transplanted to growing trays or to pots. Growing trays are the familiar plastic, celled trays which insert into a common flat. At the Arboretum we use a 5 1/2 inch deep Deep Groove Tube Tray produced by Growing Systems, Inc. 2950 N. Weil St., Milwaukee, Wisconsin 53212. It is wise to get growing trays as deep as possible because the greater biomass of prairie species is underground. Plants can be kept in the growing tray for up to one year. If the seedlings are not to be planted to the field within one year, it is advisable to transplant from the growing tray into pots. Pots are useful if the plants are to be held for more than one growing season, but it must be remembered that they take up alot of room. You must also keep in mind the root biomass to shoot biomass ratio (often 3:1) when selecting pots.

Growing media

There a several characteristics to consider when selecting a growing medium for container production of your prairie plants. It must retain sufficient moisture so watering doesn't have to be a constant worry. It should be porous to allow drainage of excess water and provide adequate aeration. It should be heavy enough to provide support for the plant and so the container isn't falling over all the time. It should be free from weeds

and pathogens. And it should be able to provide sufficient nutrients for plants which are to be kept in the medium for longer periods of time.

The components of soil mixes may include any of the following and in varying proportions: soil (usually loamy), sand, peat, vermiculite, perlite, and perhaps, compost. Soil is the major component of all soil mixes and provides the necessary nutrient exchange capacity and water holding capacity for the plant. Sand, vermiculite, and perlite provide better drainage and greater aeration to the mix. Peat and compost are typically added to provide greater water holding capacity and organic matter to the mix. Traditional potting mixtures that the Arboretum has used are:

For potting young seedlings:
1 or 2 parts sand, vermiculite, or perlite
1 part loam soil
1 part peat moss

For general, older container grown plants:
1 part sand, vermiculite, or perlite
2 parts loam soil
1 part peat

These mixes can be modified depending on the moisture requirements of the species to be grown.

Nursery Production

This is a method where the seed is sown directly to a well prepared, designated nursery. Plant roots will never see the inside of a container and, normally, when being transplanted to the restoration site the plants are dormant and there is very little soil on the roots.

Soil preparation

Soil preparation of the nursery bed is done by removal of the existing vegetation, paying particular attention to perennial weeds. After you have tilled the soil to a depth of about six inches, then rake it to remove clumps and other undesirable debris. Seed to soil contact is essential to the germination process, so be certain the seedbed is smooth.

Planting

Once you have gotten to this stage, you should have a clear plan of the nursery site on paper. Stake out the rows using string to define the rows and label the rows for future reference. Firm or tamp the rows using a hoe, rake, or by walking down the row. Plant the seed by hand as evenly as possible down the row, making sure the seed doesn't end up being clumped together. Mixing the seed with sand or sawdust aids in even distribution, particularly with the smaller sized seeds. Immediately topdress the row with ¼ - ½ inch of clean potting soil, clean topsoil, or clean compost. Next cover the topdressing with a thin layer of coarse sawdust to act as a mulch and to better define the

row. Finally, firm the area after topdressing to increase the seed to soil contact. Water thoroughly.

Post Planting

Note when germination begins, usually 2-4 weeks for those seeds which were wet stratified, and calculate the germination rate (number of seeds germinated / number of seeds planted). Next, thin the planting to 4 - 6 plants per foot for fibrous rooted species and 6 - 8 plants per foot for tap rooted species. Thinning is an important step to prevent stunting of the plants. Some of the larger species (Silphium, Penstemon) should be thinned to 3 plants per foot.

Harvesting Bareroot Plants

Digging of the plants from the nursery is best done on cool, overcast days in the spring (April to mid May) before they have broken their winter dormancy. Some spring ephemerals and early bloomers may have to be dug later, but dormancy is the key to achieving the greatest survival rate.

When digging from the nursery for transplanting directly to the restoration site, it is best to work in pairs. Standing opposite each other with long (16") bladed spades, insert the spade vertically into the soil about 4 -6" from the center of the row. Simultaneously pull the spade handles back lifting the plants from the ground. Gently shake the soil from the plant roots as you are separating the plants. It is important that the roots don't dry out, so wrap them in a folded, wet burlap bag as you are transporting the plants to be transplanted.

Asexual Propagation

There are many different types of asexual propagation, but, for our purposes we will consider only four. These include division, rhizomes, root cuttings, and bulb scales.

Division

Plants normally develop a weak point in the crown. To divide a plant, shake as much soil from the roots as possible. Feel for any weakness in the root crown which may easily be broken away. If no weakness can be found, a portion of the crown which contains a healthy bud may be cut away with a knife. All divisions must be planted quickly and watered thoroughly. It is typical to divide Viola spp., Sisyrinchium spp., Dodecatheon meadia, and many woodland species.

Rhizomes

Rhizomes are specialized stems of plants which grow horizontally at or just below the soil surface. As such, rhizomes develop buds and adventitious roots along the stem. When cutting rhizomes, make certain to have a healthy bud with each 6 inch (minimum)

piece of rhizome. Remove the older leaves and plant the rhizome horizontally. Water thoroughly.

Root cuttings

Lithospermum is commonly propagated by root cuttings. The roots should be 8 - 12 inches long, contain nodes or axillary buds, and planted vertically. Water thoroughly.

Scale division

Separate the scales from the bulbs (Lilium spp.) and plant at a depth of 2 - 4 inches. Water thoroughly. Plants propagated by bulb scale division grow slowly so it is important to mulch them to maintain soil moisture and reduce weed competition.

Timing of Planting

Please understand that this section on timing pertains only to those plants which are to be sown or planted into a flat for cold, wet stratification or into the nursery to be dug at a later date as bareroot stock. Although some of the parameters may be the same as planting to the restoration site, the intention is to apply this only to plant production.

Fall

The seed of most forb species may be planted at this time, particularly for those species which tend to be active in the early spring and/or active in late fall. Divisions for most forbs may be made after the plant has gone dormant. Dodecatheon meadia and other spring woodland herbs should always be divided and planted in the fall.

Early Spring (mid to late April)

Cool season plants and cool season grasses may be sown in early spring. These are the plants and grasses that make their appearance in the early spring and attain maximum development through early June with seed being produced by late spring or early summer. Quiessence sets in with the onset of the heat of summer and growth resumes in the fall. Needlegrass, Junegrass, and Canada wild rye are in this category. Container grown plants may also be transplanted at this time. Some species to include in this category are Aster spp., Solidago spp., Penstemon spp., Aquilegia canadensis, and others. Forbs which have not yet broken winter dormancy may be divided now.

Late Spring (May to mid June)

Prairie and savanna forb and grass species should be planted at this time. Plants grown in growing trays or pots may be planted at this time, but it is inappropriate for any division to take place.

Summer

Some spring ephemerals and early summer species whose seeds require a warm, wet stratification followed by a cold, wet stratification period can be planted to the nursery or to flats to be stored in cold frames now (June to early July). Plants grown in growing trays or pots may be safely planted at this time.

Winter

In the greenhouse, with the heat set at about 60 degrees and diverted to the underside of the flats, seed may be germinated. Plant the seeds to flats 6 to 8 weeks before your expected transplant date. As these seedlings grow, they will be ready to transplant to growing trays in late February, March or April and possibly ready to move to the nursery in late April, May or June.

Maintenance

Irrigation

Whether it's germinating seeds in a flat, plants in trays or pots, or plants growing in the nursery, it is the condition of the plants and the soil that should dictate your irrigation schedule.

Generally, freshly sown seed that has been wet stratified and germinated seedlings will require daily watering. As the plants get older and are moved to growing trays or pots they may require less frequent, yet deeper, watering because the root systems grow rapidly. It is extremely important to monitor the soil of container grown plants to avoid wide swings in moisture content. In the nursery, weather conditions, soil type, mulch presence and thickness all determine the frequency of irrigation. Plan on applying about one inch of water per week.

Fertilization

If you mixed a slow release fertilizer to the growing media of the seed flats, containers, or in the nursery, it may not be necessary to engage in a fertilization program... depending on how long the plants are to remain in the production mode. (Fertilization is not recommended for a prairie planting in the field because of the benefits to weed species and, therefore, increased competition to the desireable species.) Even with a good

soil mixture, however, it is advisable to supply the plants with additional nutrients to maintain healthy growth. Dissolvable inorganic fertilizers may be sprayed on the foliage after the first true leaves have appeared. Typically, an analysis of 20-20-20 is used in the early to mid growing season to encourage shoot growth. Changing over to 15-30-15 in the latter part of the growing season encourages root growth. Micronutrients can be supplied using a seaweed fertilizer mixture. **Please** be sure to follow the manufacturers recommended mix rates to avoid burning the plants and wasting unnecessary fertilizer. When incorporating a foliar feeding program into plant production, it is helpful to use a surfactant in the nutrient solution to aid in wetting of the leaves. Backpack or hand held sprayers, which have not contained herbicides, work the best for this application method.

Weed Control

Normally, weeds are not a problem in the container grown stock. And plucking them out as soon as you see them is easy to do. In the nursery, however, nothing works as well as weeding by hand. Control is essential to reduce competition for light, water, and nutrients, thereby ensuring the good health and continued growth of the plants you are propagating. Weeds in the aisles between the rows can be cultivated and/or mulched out of existence.

Pest and Disease Management

Common sense and good horticultural practices are the two most important practices for the prevention of pest and disease problems. Prevention is the name of the game. The application of chemicals may eradicate the pests, but it also can have an adverse affect on other beneficial organisms. Resorting to chemical warfare is to be considered extreme. Active, vigilant monitoring of plant health and the soil environment are the best ways to guarantee production of vigorous plants in the nursery. Sanitation, irrigation, cultivation and control are the cultural methods for the prevention of infestations.

EARTHKEEPING

at the University of Wisconsin–Madison Arboretum

No plot of ground is too small to grow the seeds of environmental change.

Participate in EARTHKEEPING— a program where you learn about the environment and develop a beneficial relationship with it.

Work to restore the rich diversity of plants and animals that once lived on the land. Plant a prairie, restore a wetland, or return a woodland to its natural state.

Reconnect with the natural rhythms of life as you nurture the earth around you.

WHO CAN PARTICIPATE IN EARTHKEEPING?

- Anyone who wants to make a more personal connection to the environment.
- Educators can involve young people with the environment in a positive way, while creating naturally beautiful teaching spaces.
- Homeowners can link their own landscapes with the natural heritage of the area.

Earthkeeping Applies Aldo Leopold's "Land Ethic" to Our Lives

In *A Sand County Almanac*, Aldo Leopold, the noted naturalist, wrote about an ethic that would go beyond concepts governing human relations to include the natural world ("the land"). This land ethic recognizes that just as people live in communities governed by laws and ethical behavior, they are also a part of the natural community with its own natural laws.

Restoration can help us understand the natural communities that created the world we live in today. In the midwest, the prairie community created the rich soils we now use for agriculture. By destroying this community, we remove the builder of the soil and also suffer extensive losses of soil. Studying prairies and the effect on the soil of their restoration helps us better understand how to create a truly healthy relationship with the earth that sustains us.

"When we see the land as a community to which we belong, we may begin to use it with love and respect."

—Aldo Leopold

Ecological Restoration—Earthkeeping's Focus for Action

SOME OF NORTH AMERICA'S ECOSYSTEMS

- **Grasslands**
  - Prairie
  - Savanna
- **Deciduous Forest**
- **Coniferous Forest**
- **Desert**
- **Wetlands**
  - Salt Marsh
  - Fresh Water Marsh
  - River and Stream
  - Swamp
  - Bog
- **Alpine Meadow**
- **Boreal Forest**

A natural, biotic community is a complex, interactive system of living things, influenced by non-living elements such as geology, hydrology, and climate. Prior to pioneer settlement in North America, there was a rich diversity of ecosystems, each adapted to the conditions of its particular region.

European settlement brought substantial change to the landscape. Acres of corn and wheat replaced native ecosystems. Cities occupied areas once covered by forest, prairie, or savanna. Waterways were altered and many wetlands drained. Human population pressures such as these have led to a decline of natural biodiversity all over the world.

Ecological restoration grew out of the recognition that biological diversity is essential to the health of the planet, and thus to the health of our own species, since we depend upon the land for our survival.

Restoration of native biotic communities benefits the environment by improving local biodiversity. Natural biotic communities are more stable, and need less fertilizer, fuels, and pesticides than landscapes maintained in an artificial state, such as mowed lawns or gardens of annual plants.

Preservation and Restoration

The first step in fostering biodiversity is to save remaining native communities, since it is in the context of a complete community that individual species can best survive, and their genes be preserved. But preservation alone is not enough, since so much of the natural biota has already been destroyed.

By using remnant native communities as models, restorationists seek to re-establish functioning communities of plants and animals. In some cases, restorations are used as buffers around preserved areas. In other cases, they stand alone as efforts to bring back natural communities where they were eliminated.

Restoration Projects, Large and Small

Large-scale projects often produce greater natural benefits than small ones because natural processes, such as fire, can occur and more species can be included, such as large herbivores and predators.

A small project can be very useful, however, especially if it supplies a species's limiting factor, such as a host plant needed by butterflies, or if it serves as a refuge for genetic diversity. Small projects also offer the opportunity for anyone to get involved and learn about native plants and animals.

Effective Environmental Education

Earthkeeping restorations are fertile ground for more effective environmental education. Students do something visible, tangible, and beneficial for the land, and in so doing, they discover that they can make a positive change in the relationship between people and the earth.

Starting an Earthkeeping Project

Set clear goals for your project. Create a plan that can be implemented in stages. Involve other people from the start. At schools, involve students, all staff, and parents. If you are a homeowner, let neighbors know you are trying something different and encourage them to join in—for an even larger positive impact on the local environment.

Choosing a Native Community

Learn the ecology of both the native, natural landscape and the site you wish to change. Choose a native community that matches your site's potential, one that is similar in exposure to sun, soil, and water-holding capacity of the soil.

Choose woodland if you have native tree cover or other shade on the site. Tree species and density will help determine the type of woods. Select savanna if you have partial shade provided by open-grown oak trees. A wetland is suitable where land is at least seasonally wet. In the southern half of Wisconsin, choose prairie or savanna for areas in full sun.

For example, you may have an open area with at least 12 hours of full sun in the summer. From examining surveyors' records, you find out that prior to settlement it was savanna, but all the trees have since died or been removed. Because it is rare, you may still choose to recreate savanna, although many of the savanna's species cannot be included until newly planted trees create enough shade. Or you may plant a prairie because all the shade is now gone, making the site suitable for prairie species. In addition, prairie seeds are more readily available than savanna seeds.

Formulating a Plan

A basic plan includes: site analysis; community selection; removal of alien or weedy species; preparation of the site; acquiring of native plants and animals; planting; and managing. Many *non-native* species will create problems for you when you are trying to increase the diversity of *native* plants on your site. These must be removed to allow the native species to re-establish themselves.

Though very easy to start, no project will ever be "done"— the need for improvement and increased diversity always offers more opportunities.

How Long Does It Take to Get Started?

Planning, site study and preparing the ground often take a full year. During that time, collecting seed provides wonderful experiences before planting. Seed or plants may also be purchased. Seed is usually planted in the spring following the year of preparation.

Start small; your return will come sooner and be proportionately greater. Teachers can spread the project out so different grades may accomplish specific steps and future classes experience restoration.

Few prairie species will bloom in the first two years of planting from seed, and you can expect to wait as many as four or five years for other species to flower. Many woodland wildflowers also take many years to flower when planted from seed.

EARTHKEEPING IS FOR STUDENTS

- **Hands-on learning.**
- **Goal-oriented, real-life problem solving.**
- **The personal connection to the environment needed for increased motivation and action.**
- **A new way of looking at the world and their behavior towards it.**
- **Real work with real results that builds interest and self-esteem.**

Detailed information on starting an earthkeeping project is contained in the Arboreum publication, Prairie Restoration for Wisconsin Schools.

Contact the Arboretum for information on this publication, workshops, classes, tours, and other materials.

EARTHKEEPING IS FOR EDUCATORS

- A way to lead students through example—actually taking care of the environment, not just talking about it.
- An opportunity to learn/teach about long-term processes, as well as products.
- An arena to explore study of environment as a possible basis for restructuring curriculum.
- Creates sites useful for teaching now and into the future.
- Enhances teaching of the scientific method.
- Suitable for multi-disciplinary thematic and whole language instruction, enhancing teaching of all subjects.
- Promotes closer work among peers and potential net-working throughout the state.
- Establishes community connections through cooperative projects and common interests.
- Fulfills the Wisconsin Department of Public Instruction mandate for effective environmental education.

Earthkeeping at Your School

Teachers and students take responsibility for a small corner of the school-yard—not the whole lawn, but enough for an experiment. Is it possible to replace that piece of lawn or dirt with plants and animals native to the area?

They explore and compare the schoolyard and a nearby native community, perhaps a remnant of prairie. Both are very sunny spots with similar soil. Hands-on activities show the diversity of grasses, flowers, and critters that call the prairie home. By comparison, the lawn has few plants and animals and little aesthetic change through the seasons. The group decides it will try recreating a prairie in place of some lawn.

Everyone pitches in to map, measure, count plants, create plans, and write stories to inform parents and other students about the project. Students cover bluegrass with mulch to prepare a site, gather prairie seeds, tell and hear stories about prairie pioneers, plant, weed, and celebrate the return of one tiny piece of land to prairie.

Their scientific learning grows, too, and local history comes alive as they develop a sense of place. The art classes help with posters, t-shirts, and other projects which explore the prairie in a different way. Students use art to advertise, explain, and raise funds for the project. In Phy-ed, students learn games played by pioneer and Native American children. The music teacher finds songs and ballads from prairie settlement times. All grades can become involved, and students can look forward to the prairie activities they will do throughout coming years.

The Earthkeeping Program at theUW Arboretum

For more information on the Arboretum's programs and publications, contact the the McKay Visitors' Center, (608) 263-7888.

At the University of Wisconsin–Madison Arboretum we help citizens, teachers, and students restore the local environment while they learn about the native biotic communities that once covered Wisconsin.

We Can Help You Start Your Own Project!

Visit the Arboretum to see its restored prairies, forests, and wetlands—the world's oldest, ongoing plant community restorations. Here you can see the dramatic results of the first restorations, including beautiful Greene Prairie, planted almost single-handedly by Henry Greene on a former corn field, and Curtis Prairie, begun in 1934 by the Civilian Conservation Corps under the direction of Ted Sperry. This is where University of Wisconsin ecologist John Curtis documented the importance of natural processes, such as fire, to the health of a prairie restoration.

- Take classes in seed collection, wildflower identification, plant propagation, site analysis and management
- Come on free weekend tours
- Participate in volunteer training and restoration projects
- Enroll children in summer programs
- Grounds are open year-round from 7 am to 10 pm daily

Special Programs for Educators

- Tours for teachers and students
- Inservices for school faculties
- Restoration workshops for educators
- Consultation, visits and restoration advise from our staff

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University of Wisconsin-Madison Arboretum's
Earth Partnership Program

Resources Available

Prairie Restoration for Wisconsin Schools

Three ring binder includes a guide to restoration from site analysis to management, an activity guide of approximately 100 interdisciplinary, K-12 restoration-based activities, scope and sequence, species list, seed collecting dates, seed and plant propagation, bibliographies and a native plant nursery list.

$20.00 (+ shipping and tax, if applicable)

$18.00 Friends of the Arboretum (+ shipping and tax, if applicable)

A Prairie Journey slide show

A 20 minutes slide show and written narration that introduces the natural and cultural history of the prairies and an overview of the prairie restoration movement. 73 slides.

$35.00 (+ shipping and tax, if applicable)

$31.50 Friends of the Arboretum (+ shipping and tax, if applicable)

A Prairie Journey video

This 25 minute video covers the same content as the slide show but includes more images. Students narrate, play the background music and provide artwork.

$20.00 (+ shipping and tax, if applicable)

$18.00 Friends of the Arboretum (+shipping and tax, if applicable)

Order Form

Quantity		Total
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